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FUNCTIONAL GAP ANALYSIS OF THE MARITIME OPERATIONS CENTERS

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ABSTRACT

The Maritime Operations Centers (MOCs) are an integral part of the Navy's Maritime Headquarters (MHQ) concept for Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) structure. The purpose of this study was to determine if the mission of the MOC could be accomplished with the existing C4I systems assigned. By tracing functions to systems, gaps were identified which created a foundation to investigate whether systems currently in development were available to meet these gaps. In some cases, candidate C4I systems were proposed to fill gaps. System functionality overlap was also noted.

As a by-product of our research into the MOC concept and analysis of its required functions and candidate component systems, we have proposed a methodology for future work in the design of the MOC architecture. Through the use of requirements analysis tools, we have been able to structure the requirements, functions and proposed systems of the MOC architecture in a way that automates the tasks of functional analysis and system architecture design. Future work on the MOC requirements and architectures should utilize these or similar automation.

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EXECUTIVE SUMMARY

The Maritime Headquarters with Maritime Operations Center (MHQ with MOC) concept was envisioned as a way for the Navy to standardize the command structure in order to support naval, joint, and multinational roles and responsibilities at an operational level while maintaining the flexibility to act as Navy component commanders, Navy forces commanders, joint force maritime component commanders (JFMCC), and joint task force commanders (JTF CDR). Before the MHQ concept, operational-level commands each had differing processes and procedures on how to transition between operational roles, with ad-hoc training occurring as roles were assigned. The MHQ with MOC concept allows for a standard baseline of processes and procedures for managing fleet forces and conducting operations with trained personnel able to execute tasks in any of several MHQs across the globe.

The MOC, with a standard baseline of Command, Control, Communications, Computers and Intelligence (C4I) component systems, is essential to the scalable, orderly management of the operational activities of the MHQ. The MOC houses the tools that the MHQ requires to execute its mission, providing collaboration tools, communications, situational awareness, and command and control utilities. These tools enable the MHQ to assess, plan, and execute the operational objectives of the MHQ commander. The MOC consists of both land-based elements within the MHQ and forward shipboard elements for responses to areas of crisis.

A C4I baseline of MOC systems has been proposed by the Program Executive Office for C4I (PEO C4I). It is encompassed in a Spiral approach to fielding, with full capabilities estimated in Fiscal Years 2012-2015. Spiral 8 consisted of the fielding of the majority of existing C4I systems for Command and Control including the Global Command and Control System (GCCS) Family of Systems including Maritime (M); Integrated Imagery and Intelligence (I3); and Joint (J). Spiral 10 provided additional networking capabilities and upgrades to the MOC systems. Further Spirals will bring the MOC in line with Consolidated Afloat Networks and Enterprise Services (CANES) and incorporate items from Maritime Domain Awareness (MDA) Spirals as those capabilities become available.

As the architecture of the MOC was developed according to the Department of Defense Architecture Framework (DoDAF), the process flows of the MOC were documented in a set of architecture artifacts. Documents contained lists of operational activities and tasks required for their completion. To ensure these tasks and activities would be covered by the recommended C4I systems, it was necessary to trace the process flows to the component system level and observe gaps and overlaps in how the required tasks were accomplished.

Utilizing architecture design software tools, we were able to trace the originating requirements from items in the Universal Joint Task Lists (UJTL) to the component system level. The use of automated tools is highly recommended for future work on MOC requirements as it allowed for concise graphical displays of the functions of the MOC and easy identification of gaps in the capabilities of available systems. It also allowed for construction of system views and other architecture products from a common database.

The results of our analysis found several areas where gaps existed, meaning that currently available C4I systems were unable to meet the required tasks of the MOC. In some cases the activity was described in earlier documents as being completed solely through the use of a computerized tool, but the team’s analysis determined it to require more specialized work with human involvement.

This report is organized into five main sections. Section I, the introduction, describes the MHQ with MOC concept origins and background for this project, with a breakdown of the MOC core processes. Section II describes the research conducted by the group for the production of this work and the completion or our tasking. Section III describes the methodology applied to our work and the systems engineering approach used in this project. Section IV provides the validation of the methodology through the analysis of the core process flows and component systems. The final section provides a summary, conclusions, and recommendations for future analysis of the MOC concept.

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1 INTRODUCTION

1.1 PROBLEM STATEMENT

Operations conducted over the past decade have identified gaps in the Navy's Command and Control (C2) capabilities needed to support modern Navy doctrine. Naval combatant operations, joint operations, and humanitarian relief missions have been severely hampered by these shortfalls. Capabilities that have exhibited limitations include the following:

- Ability to command in a dynamic environment.
- Ability to rapidly identify necessary participants or communities of interest across echelons for planning and response to crisis action.
- Ability to efficiently collaborate and receive rapid feedback to assess and adapt to emerging conditions and shortened planning/execution timelines. (U.S. Fleet Forces Command, 2007)

The Navy's answer to these shortfalls is the establishment of Maritime Headquarters with Maritime Operations Centers (MHQ w/ MOC) to effectively execute the necessary operational missions while eliminating the identified C2 gaps. The standup of the MOCs was the first step in this process, but non-standardized systems and procedures have contributed to some of the gaps that were to have been eliminated. Commanders utilized the systems already present or individually acquired systems from PEOs that partially fulfilled some identified mission requirements. There was little or no consideration for interoperability between systems within or between MOCs and no System of Systems analysis has been conducted to identify the complete set of functions or requirements the MOCs must perform. These are essential steps in the process of designing and implementing MOCs that will efficiently and effectively conduct the required missions.

1.2 CAPSTONE PROJECT DESCRIPTION

System analysis tools were used to identify gaps and overlaps in capabilities by tracing the MOC architecture to the component level. Through the use of the tools, the tasks as described in the Universal Joint Task Lists (UJTL) were mapped to the MOC functions and the individual Command, Control, Communications, Computer and Intelligence (C4I) component systems identified to execute those functions. Systems planned for the MOC Spiral 8 and Spiral 10 baselines were examined to determine whether they were able to accomplish the functional requirements. Where no component systems were able to sufficiently meet the requirement, gaps were noted. Similarly, where several systems meet the same requirements, the overlap was noted. Issues discovered during the analysis regarding tasks assigned to the MOC are described in detail in Section 4.

In an effort to apply a systems engineering approach to our work with the MOC concept, different approaches to systems engineering were compared for consideration. The “variations” listed in Blanchard and Fabrycky (2006) provided several approaches that could be appropriate, but the one selected to support the development of the MOC concept was quoted by Blanchard and Fabrycky from the Department of Defense (DoD) Regulation 5000.2-R of 2002. The definition quoted by Blanchard and Fabrycky is as follows:

> *An approach to translate operational needs and requirements into operationally suitable blocks of systems. The approach shall consist of top-down, iterative process of requirements analysis, functional analysis and allocation, design synthesis and verification, and system analysis and control. Systems engineering shall permeate design, manufacturing, test and evaluation, and support of the product. Systems engineering principles shall influence the balance between performance, risk, cost and schedule (Blanchard & Fabrycky, 2006).*

Inconsistencies with applying this approach have been identified in both previous and ongoing Navy efforts to develop the MOC concept. Regardless of the approach that was chosen for the MOC development, the "common threads" of systems engineering present in all definitions appear to be lacking. Blanchard and Fabrycky also cite some of the "special areas of emphasis" that should be noted in conducting systems engineering. They state:

> *A better and more complete effort is required regarding the initial definition of systems requirements, relating these requirements to specific design criteria, and the follow-on analysis effort to ensure the effectiveness of early decision making in the design process. The true system requirements need to be well defined and specified, and the traceability of these requirements from the system level downward needs to be visible (Blanchard & Fabrycky, 2006).*

The lack of requirements traceability for the process flows of the MOC, as defined in the currently available operational event-trace description (OV-6c) and other documents, as well as an absence of approved formal documentation on which to base future, lower-level system design, has resulted in the inability to determine appropriate system baselines that guarantee the presence of the functional capabilities necessary to successfully conduct the MOC mission. These issues are covered more in depth in Section 3.

1.3 BACKGROUND

1.3.1 MHQ with MOC Concept

The MHQ with MOC concept was envisioned to standardize the processes and procedures in which a Navy Combatant Commander assesses, plans, and executes activities at the operational level (U.S. Fleet Forces Command, 2007). Vice Admiral M.G. Williams, Jr., former Deputy Commander U.S. Fleet Forces Command, stated the overall purpose of implementing the MOC concept is “to provide common processes and methods to allow different Maritime Headquarters to evolve towards standardization of assessment, planning and execution at the operational level of war.” (U.S. Fleet Forces Command, 2007). It enables the Combatant Commander to effectively fight the Global War on Terror (GWOT) and manage Naval assets while remaining flexible enough to adapt as necessary to crisis situations as they arise. Each MHQ would be part of a global network enabling high-speed net-centric communications, collaboration, and data sharing. Standardization of MHQ processes and procedures would allow for coordinated training of MHQ staff and a baseline standard set of component systems used in the MOC. MOCs would have the ability to scale operational activities to respond to crisis as they arise and return to normal operations when they are resolved.

Figure 1 depicts the staffing of the MHQ, which handles both Fleet Management activities and Operational-Level activities, both of which are aided by a shared support staff with specialized skills that can be tailored given the Combatant Commander’s (CCDR’s) operational environment.

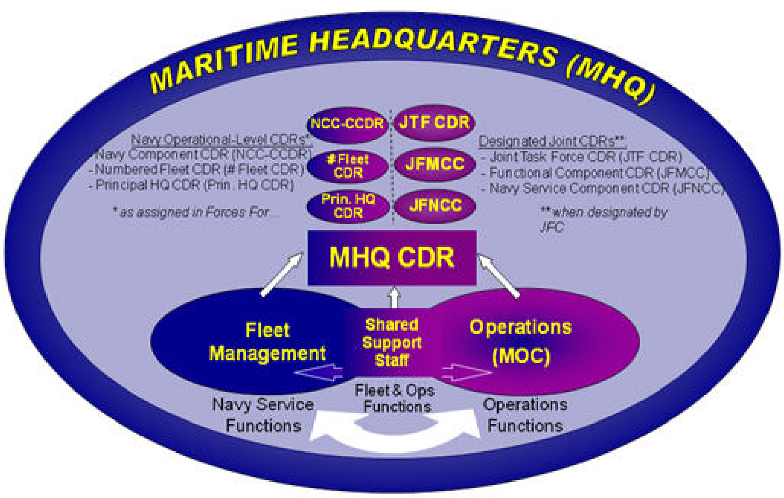

Figure 1 - MHQ Staffing and Roles

This diagram highlights the dual role of the MHQ with responsibilities in the Fleet management and Operations. (Department of the Navy Chief Information Officer)

The MOC component of the MHQ was envisioned as a system-of-systems, (SoS) both physical component systems and staff personnel, who would be assigned to various cells, bureaus, or working groups, coordinating as needed to perform the various activities of MOC operations. The MOC would act as a process-driven entity following the paradigm of Assess, Plan, and Execute (U.S. Fleet Forces Command, 2007). This paradigm, although not aligned exactly with the Navy's Command and Control doctrine, does fulfill the intent (Naval Doctrine Publication 6 (NDP 6), 1995). In this way, a MOC would continually assess the overall naval environment within the area of responsibility (AOR) as it pertained to operational objectives. Based on those assessments, the MOC would plan activities to meet operational objectives and monitor their execution by subordinate tactical forces, then assess the effects of those operations.

1.3.2 MOC Core Processes

In order for the MOC to perform the necessary functions for operational-level operations, a set of standardized core processes was developed following the guidelines of Joint Capabilities Alignment (JCA) and derived from the UJTLs (Joint Staff, 2008). These core processes form the bulk of operations to be performed by the MOC and, as listed below, form a baseline that can be scaled if the situation warrants. They were developed further within the architecture products that included Operational Views (OV), System Views (SV), and Activity Views (AV). The OV-6c relates the tasks and activities necessary to accomplish the process flow.

The MOC Core Processes used in this analysis were taken from the OV-6c documentation and are provided in Table 1 with a brief description.

Table 1 - Core Processes Descriptions

Core Process	Description
Assess Effects	A continuous assessment of the effect of current missions and operations conducted by the MOC, going beyond initial success or failure indications to assess whether follow-on action is necessary and how changing environment and battlespace affects the operating scenario.
Operational Intelligence	Determine what critical intelligence information is needed to complete operational objectives, bringing to bear all intelligence gathering assets at the MOCs disposal.
Operational Planning	Operational Planning is used to ensure that employment of forces is mapped to operational and mission objectives. Allows for coordination of Naval operations in joint force activities.
Manage Information	Ensure that the command has the information necessary to complete operational and mission objectives will managing/minimizing information overload.
Establish HQ	Perform all necessary tasks to setup a MHQ command structure, establish decision authority and delegate mission planning and execution organizational authority
Execute Plans	Oversees and monitors the execution of plans, assess their performance and adapt as necessary.

1.3.3 Approach

The methodology chosen to guide our efforts consists of a five-phase approach incorporating the systems engineering principles discussed earlier. Efforts were organized into research, requirements, relationships, analysis and conclusion. Each phase accomplished a specific purpose that supported each subsequent phase. Even though timelines were established for each phase, this only changed the focus of efforts by team members. Continued work on previous phases did not stop entirely. For instance, research continued throughout the entire life of the project, but the bulk of the effort was accomplished early on. Details of each phase are addressed in Sections 2 and 3.

2 RESEARCH SUMMARY

2.1 OVERVIEW

The first objective was to gain an understanding of the Maritime Headquarters with Maritime Operations Center (MHQ/MOC). The key questions to answer were 1) what is a MOC, 2) what is the purpose of the MOC and 3) what are the operations and functions of the MOC. To answer these questions the team started basic information gathering. Team members began searching the internet, using Google, Yahoo, and other search engines for both commercial and military references. The online Dudley Knox Library at the Naval Postgraduate School was utilized, including database searches and librarian assistance.

Team members began working with the MOC Working Group, mostly involved with the MOC Architecture Integrated Product Team (IPT), reviewing documents and interviewing its members. The team met with the sponsor, LCDR Bill Brown, Deputy for the Space and Naval Warfare Systems Command (SPAWAR) Model & Simulation department, for his input on the history and current direction of the MOC. Over the course of the project, team members also met with several Subject Matter Experts (SMEs) from SPAWAR to include the Technical Director, Dr. Bill Rix; Chief Systems Engineer for Networks, Raymond Buchholz; and Chief Systems Engineer for Large Decks, Michael Davis. The team also met with our advisor John “Mike” Green on several occasions to gain insight on the MOC and to structure and focus the effort of this project.

Once the team had answers to the key questions, the research focused on gaining knowledge of the requirements driving the MOC concept. These driving requirements in turn lead to the establishment of a process and methodology for determining the capabilities, or lack of capabilities, defined in current MOC documents.

2.2 SCOPE AND DEPTH

Numerous documents and articles were collected and reviewed to gain insight and knowledge on the MHQ/MOC. The bibliography section of this document lists the documents reviewed for the development of this report. The documentation collected ranged from presentations, articles, requirement documents, and minutes. Among the references collected, the following documents were extremely useful in providing the overall requirements: UJTLs, architectural views (SV-4a, SV-5a, SV-8, OV-6c), MHQ/MOC Concept of Operations (CONOPS), and the MOC System Descriptions document generated by PMW-790 and provided by Raymond Buchholz, the SPAWAR Chief Systems Engineer for Networks.

This research led the team to review the CORE® Architecture Definition Guide (DoDAF v1.5) documentation. The team decided to use CORE® 5.1.5 due to its capability of developing operational architectures based on the MOC CONOPS. The operational architecture for MOC also required the team to enter the system and process requirements into the CORE® application. CORE® is capable of producing architectural views of the MOC, allowing an analysis of the capabilities and functions. The team utilized the graphical views generated in CORE® to identify gaps in the capabilities of the MOC as provided by the systems included in the implementation of the MOC concept.

2.2.1 Research Phase

The goals of the research included gaining familiarity of the MOC concept, the history of events leading to the formal initiation of efforts in the development of the MOC concept, the requirements driving the development of the MOC concept, the level of effort expended to date on development, and the current state of execution. The focus was on the military sources, but included research on commercial influences. Sources included, but were not limited to, interviews of stakeholders and subject matter experts, personal involvement in IPTs, the use of the World Wide Web, program office document repositories, and the Naval Postgraduate School online library and journal search capabilities.

Early research exposed the team to various IPT artifacts including architecture products. The most relevant of these architectures were the System Views and Operational Views provided by the Architecture IPT. These artifacts quickly became the foundation of our research, allowing us to scope our efforts into a manageable undertaking. The views most influential in our research included the SV-4a, SV-5a, SV-8 and OV-6c. The draft nature of each artifact limited their value, but highlighted the fact that development of the MOC concept is being driven forward without solidified requirements and with inadequate architecture descriptions. The lack of a formal requirements document was confirmed in a discussion with the Navy's Chief Systems Engineer (CSE) for Large Decks (Davis, 2009). CSEs are responsible for conducting Technical Authority reviews, representing the SPAWAR Chief Engineer.

G. Derrick Hinton, Chairman of the International Test and Evaluation Association, stated the importance of architectures in the systems engineering process and for expanding beyond point solutions "by creating an architecture as the central aspect of the requirements and design process." He further stated the role of architecture as the "bridge from requirements to design, in which the most important, critical or abstract requirements are used to determine a basic segmentation of the system." (Hinton, 2006)

Without validated requirements, a relevant architecture cannot be developed. The desired end state cannot be accurately expressed without the relevant architectures. The architectures are the "blueprint" for moving beyond a concept. Just as a house can be built without blueprints, so can a system, but what is the reliability of the outcome? To further complicate the situation, the MOC concept requires implementation of a System of Systems. Although numerous definitions of a SoS exist, the following is most closely applicable to the MOC concept:

In relation to joint warfighting, system of systems is concerned with interoperability and synergism of Command, Control, Computers, Communications, and Information (C4I) and Intelligence, Surveillance, and Reconnaissance (ISR) Systems. Primary focus: Information superiority. Application: Military. (Manthorpe, 1996)

The complexity of SoS relationships, accommodating interoperability and system interfaces, cannot be accurately described without architectures. The relationship between elements and interfaces is not a one-to-one relationship. On the contrary, there is an exponential increase in interfaces as elements are added to the equation. Citing Metcalfe's Law, while ignoring disputes on its continued validity (Briscoe, Odlyzko, & Tilly, 2006), the number of connections a component can make with other components in a network equals:

$$n(n-1) \tag{1}$$

or roughly n^2 as n increases, with n being the number of nodes on the network. Because the systems being proposed for inclusion into the MOC are not all interfaced, the system-to-system and human-to-system interfaces are even more complex if not ambiguous. Therefore, every time a new system (node) is proposed for inclusion into the MOC SoS, the effects cannot be clearly recognized.

3 METHODOLOGY: SUBSEQUENT STEPS

3.1 REQUIREMENTS

Once team members had an understanding of the work that had been conducted on the MOC and the supporting artifacts, the focus changed to understanding the requirements that were driving the work. In order for the work to be seen as relevant, it must support traceability to the source requirements; therefore we acknowledged the need to first identify those source requirements. Research of program document repositories and discussions with key personnel has supported the absence of any validated requirements.

Without formal validated requirements, the decision was made to trace the tasks provided in the OV-6c to the original source documents. The MOC CONOPS describes core processes that support "standardized processes and methods that are fully compatible with both service and joint guidance" with the goal of facilitating the sharing of information, coordination, and load sharing between MOCs when necessary (U.S. Fleet Forces Command, 2007). It specifically cites an analysis of the UJTLs as the foundation of the MOC core processes. This document also credited the operational architecture as the source used to compile the descriptions of the core processes to include "inputs, major players, and products." Involvement with the MOC Architecture IPT made it clear that the architectures were still evolving, yet these artifacts were the foundation for the development of the processes that define the MOC. Review of the architectures published to the Department of Defense Architectural Repository System (DARS) revealed numerous references to draft documents as resources in their development. One specific example in the OV-5 Activity Model, the operational task of Prepare Plans and Orders (OP 5.3) cites the draft version of the Capabilities Development Document (CDD) for the Net-Enabled Command Capability. Further research is necessary to determine if there has been sufficient configuration management implemented to account for changes to referenced capabilities and the effect those changes may have had on the processes and systems developed around the originally proposed capability.

The absence of validated requirements and architectural views brought to question the inherent limitations in the accuracy of the initial analysis conducted in order to establish the core processes. It was recognized that numerous assumptions of validity were necessary in order to move forward. Although the UJTLs were accepted as the authoritative documents for the operational activities of war, the knowledge and experience of those persons who conducted the analysis of the UJTLs to develop the core processes is unknown. Every element of warfare has been addressed in the CONOPS and other artifacts, and an underlying assumption has been made that the resultant products are valid.

3.2 RELATIONSHIPS

The following paragraphs describe the team's efforts to identify relationships between MOC tasks and systems. This began with a review of the published architecture views in DARS. Systems Architect (viewer) is the software tool used to examine the architecture products maintained in DARS. In addition to viewing the products, the system also provided background information on each of the elements, such as which documents were used referenced during the generation of the view.

If the published architectures are considered to be valid, the existing depiction of required actions in the OV-6c can be used to establish the relationships between activities and systems and generate a valid Operational Activity to Systems Function Traceability Matrix (SV-5a). The draft SV-5a developed by the MOC working group currently exists in an Excel spreadsheet in the form of a matrix with 1,067 rows and 517 columns, which are split between three different worksheets. This matrix consists of 551,639 cells that are meant to identify relevant information, and the data it contains is entered and tracked manually.

The limited usefulness of the draft SV-5a can also be attributed to the lack of validated requirements. At the time of review, the 1,067 rows in the matrix listed the required system functions proposed by the working group, most of which had not been derived from the MOC processes. On the contrary, the list of functions appeared to have been developed independently of the core processes and was drawn from sources such as the Common Systems Function List (CSFL) and FORCEnet System Functions (FnSF). Some "new" system function requirements have been included by unidentified persons, but as they were included, they were not traced to governing documentation. In May of 2009 the Architecture IPT augmented the efforts to identify relationships to the core processes.

3.2.1 Conceptual vs. Reality

Development of the MOC concept into reality has posed many challenges. One such challenge is the goal to provide the capabilities desired by the customer as quickly as possible. As development of the MOC concept progressed, the need to incorporate greater capabilities resulted in decisions to include conceptual systems that had not been fielded (and possibly never would be) into the design. And though this is not an uncommon practice in acquisition, the risk associated with doing so must be acknowledged. This approach has been seen frequently in the attempt to present the MOC concept as an achieved reality. Documents depicting Spiral builds with changing baselines have been signed and released, but with the inclusion of "drawing-board" systems and placeholders that describe future capabilities instead of achieved technology.

3.2.2 Interoperability vs. Integration

During the relationship phase, the discussion of multiple systems involved in single core processes inspired numerous discussions on requirements for information sharing or transfer between systems to accomplish a given task. Although the issue was determined to exceed the scope of our analysis, the fact remained that these relationships would have to be defined. Normally accomplished in a program's Information Support Plan (ISP), these relationships would be clearly delineated and each interface would require interoperability testing as appropriate. Research into the MOC effort revealed no such document. Our analysis acknowledged the inclusion of multiple systems in various core processes and defaulted to the assumption that appropriate interoperability or system interfaces existed, whether man-to-machine or machine-to-machine. Further analysis will be required to determine the extent of interoperability required in the MOC construct as well as data format as it affects the exchange of information.

3.2.3 Tracing

The actual process of tracing relationships of tasks to systems was divided among team members and the results were entered into the software tool chosen to assist in the analysis. CORE® 5.1.5 was chosen by the team to provide automation in the tracing process. The availability of CORE® through the NPS Virtual SE Lab allowed access by all members. An assessment of the capabilities of the tool determined it would provide the necessary functionality to accomplish our goal. An Analysis of Alternatives identified it as the most appropriate solution to our automation needs based on availability, cost and performance.

Initial efforts attempted to trace systems to tasks beginning with the individual tasks drawn from the OV-6c. It quickly became apparent that redundant efforts were occurring because different members of the team were tracing the same core processes owing to the existence of a one-to-many relationship between core process and joint tasks. The team revised the approach by distributing the domains that were composed of the different core processes: *Assess Effects; Operational Intel; Operational Planning; Manage Information; Establish Headquarters;* and *Execute Plans*. This ensured no redundant activities were assigned while distributing the workload nearly evenly.

To assist in the tracing, an Excel spreadsheet was created that consolidated the parent and child activities into a useable format for each of the core processes (Figure 2). This eliminated the need for each member to search through numerous pages of flow diagrams in the body of the OV-6c. Information was first entered into the spreadsheet to facilitate a quick transcription into CORE®, thus limiting the time spent operating in the Virtual Systems Engineering Lab. Individual tabs in the spreadsheet corresponded to each mission area domain. Each core process was then broken down into parent and child activities corresponding with those in the OV-6c. Columns were provided to identify the system allocated to accomplish the task and the spiral build the system was assigned to if applicable.

	A	B	C	D	E	F	
1			Spiral 8	Spiral 10	System		Issues
38	EP.1.3	Synchronize Execution Across All Domains	JADOCS		JADOCS; C2PC	1	CPOF; DJC2
39	EP.1.7	Collaboratively, Rapidly Replan Operations			C2PC	1	CPOF; DJC2
40	EP.2	Provide CDR's Update					
41		MHQ Command Element					
42	EP.2.1	Approve Planning Guidance			C2PC	1	System not requi
43		Future Operations					
44	EP.2.2	Develop Priority of Effort			GCCS-M/J/I3	1	
45	EP.2.3	Shape Guidance w/Mission Partners' Concerns in Mind			GCCS-J	1	
46	EP.2.4	Develop the Commander's Planning Guidance			GCCS-M/J/I3	1	
47	EP.2.5	Make Commander's Planning Guidance Visible/Accessible	NCES		NCES	1	
48	EP.3	Manage Health Services					
49		Shared Support					Is Shared Support
50	EP.3.1	Request Health Services Support	NCES		NCES	1	
51	EP.3.2	Coordinate Health Service Allocation	NCES	DCGS-N	DCGS-N; NCES	1	
52	EP.3.3	Submit Patient Movement Request		M3	M3	1	
53	EP.3.4	Transmit MEDEVAC OPS Info		M3	M3	1	
54	EP.3.5	Receive MEDEVAC OPS Coordination Info	NCES	M3	NCES; M3	1	
55	EP.3.6	Coordinate Patient Movement	NCES		GCCS-M/J; NCES	1	
56	EP.3.6.1	Administratively & Clinically Validate Patient				0	

Figure 2 - CORE® preparation

A spreadsheet derived from the elements of the OV-6c was developed to streamline the capture of information and minimize the time spent transcribing date into CORE® while logged into the Virtual Systems Engineering Lab on the NPS network.

3.2.4 CORE® Schema

The resulting spreadsheets were transcribed into the CORE® 5.1.5 tool on the NPS Virtual Systems Engineering Lab. As seen in Figure 3, the Systems Engineering schema was selected, although the DoDAF schema was considered as an alternative. Further consideration for appropriate schema selection, or creation, is recommended for future efforts using the tool, but the schema selected was determined to be more appropriate for this project.

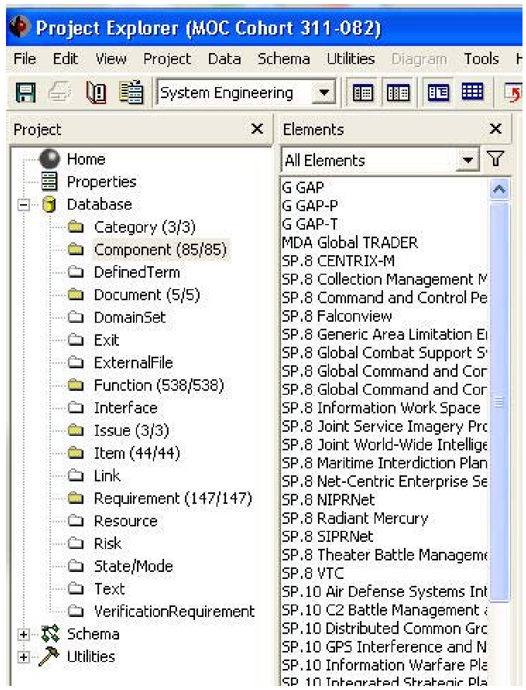

Figure 3 - SE Schema

This screenshot of the SE Schema within CORE® shows which elements were used to conduct the analysis.

Elements in the Systems Engineering Schema that were utilized in the relationship tracing included Component; Document; Function; Issue; and Requirement. The first step in setting up the schema was to determine what information was necessary to create the elements within the CORE® project.

3.2.5 CORE®: Requirement

The MHQ MOC CONOPS provided the information necessary to derive requirements. The mission area descriptions in the CONOPS identified the responsibilities of each element and sub-element within the MOC organization. These were drawn out as individual requirements to which the functional requirements could be associated and were entered into CORE® as "Requirement." As they were entered, a relationship of "documented by" was established with the CONOPS in order to validate the requirement.

3.2.6 CORE®: Function

The OV-6c provided to the team identified the necessary functions. Each process flow identified consisted of a string of parent and child activities. Each of these activities had to be accomplished in order for the core process to be completed, and it was the completion of these core processes that provided the capabilities necessary to accomplish the identified mission. These activities were designated as "Function" in CORE® and became the target of the functional tracing that would determine if capability gaps existed. As they were entered, a relationship of "decomposed by" was assigned to child activities in relation to the parent activity from which they were derived. This established the hierarchal relationship to be used for the gap analysis. If a child activity could not be completed, the parent activity also could not be completed. This allowed for an in-depth analysis that would not be apparent otherwise.

3.2.7 CORE®: Component

The ultimate goal of this project was to assign systems to functions in order to determine if the MOC could accomplish the missions assigned to it using those systems. The entire effort hinged on the ability to identify and assign those relationships. One barrier that was presented was the ability to identify systems that would become standardized in their use by the various fleet customers. Without that standardization, each MOC could utilize their solution and one basic goal of the MOC concept would remain unrealized. During the research of documentation, two letters signed out by the Director, Warfare Integration (N6F) only one year apart were discovered that were meant to accomplish that standardization. The first, with the subject "MARITIME HEADQUARTERS WITH MARITIME OPERATIONS CENTER (MHQ w/MOC) SYSTEMS REQUIREMENTS" provided an enclosure listing the systems that were to comprise the spiral 8 baseline (Director, Warfare Integration N6F, 2007). The second, with the same subject, was to be the update with the spiral 10 baseline (Director, Warfare Integration N6F, 2008). The expectation that the spiral 10 baseline would include the systems from the spiral 8 document was not realized. The spiral 10 document only referenced the previous release and showed only the newly identified MOC systems. Although the information did exist, the ability to obtain the official documentation was less than efficient. These highlighted the need to baseline system composition in a single location or, at a minimum, provide additional enclosures to subsequent baseline updates that show all of the systems to be included.

3.3 ANALYSIS

Upon the conclusion of establishing the relationships between the activities that comprised the core processes, an analysis of the tracing efforts began. The benefit of entering the data into an automation tool was the ability to manipulate views based on the level of detail desired. The overall view helped to establish a perspective of the undertaking at hand. There were 496 functional activities included in our analysis. These activities encompassed the derived actions necessary to accomplish only 44 tasks. With an undetermined number of tasks that would comprise the entire portfolio of mission requirements, the complexity of a complete analysis can be inferred. That knowledge should be considered when considering the method by which requirements will be continually assessed as the MOC concept evolves and additional systems are considered for inclusion.

Automation could contribute to a true conditional consequence analysis as the complexity of the relationships increases according to aforementioned Metcalfe's Law. As the configuration of the MOC continues to evolve, obsolete systems will be considered for replacement or new capabilities will be achieved with additional systems. The interfaces identified for each system would allow a rapid assessment of the consequences for removing a system, which activities are affected by that removal, and whether those capabilities can be achieved by the replacement system or through some other interface.

3.4 ARRIVING AT CONCLUSIONS

The final phase of the team's project was the formulation of a conclusion to the question of whether a MOC can complete the missions assigned based on functional capabilities present in the configuration of systems. The analysis did show the existence of capability gaps; therefore the MOC will be unable to perform the missions assigned with organic systems unless capability augmentation is conducted. This conclusion will be explained in greater detail in Sections 4 and 5.

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4 METHODOLOGY APPLICATION AND VALIDATION

This section summarizes efforts executed in support of the MOC traceability project described in Section 3. It further documents and examines the capability gaps in implementing MOC. The following sub-sections provide detailed findings of the analysis.

As detailed in Section 3, well-documented systems engineering (SE) processes were not used in earlier studies generating MOC requirements. Lack of SE process is evident in the DoDAF artifact, OV-6c, as it struggled to decompose the high level MOC requirements into business rules and tactical functions. The following sub-sections describe the gaps discovered when trying to allocate the requirements to systems.

4.1 EXECUTION OF OVERALL APPROACH

The MOC requirements were obtained from the CONOPS, the OV-6c, and several high level directives. Our Capstone team applied several methods in conducting the functional analysis. Initially, the team identified a small pool of systems that could fulfill the six top-level MOC functional areas. This initial analysis was conducted utilizing a Microsoft Excel spreadsheet and was conducted before specific systems planned for the MOC were known to the team. Once the Spiral 8 and Spiral 10 systems were identified, the Capstone team repeated a similar Microsoft Excel analysis. The final gap analysis was conducted in CORE®.

4.1.1 Section Overview

Requirements were allocated to systems using CORE®, a systems engineering tool used to document, decompose and allocate requirements. The remainder of this section discusses the steps taken to populate the requirements into CORE®, find association to other requirements (if any), allocate them to systems, and identify gaps where systems have not been identified to satisfy a given requirement.

As described in Section 3, because the number of functions developed by the MOC Architecture IPT was so high, our capstone team had to first identify the ones that were traceable to requirements. Instead of the 1,067 functions listed in the SV-5a, the team identified and uploaded to CORE® 496 tasks extracted from the OV-6c. Similarly, the known requirements documents, reference documents, and components were identified and uploaded into CORE®.

Next, relationships between functions were identified and established in CORE®. In this process, some of the tasks were identified to be children, or sub-functions, of other functions. Identification of relationships between tasks assisted in the decomposition of high-level requirements to lower-level requirements that could then be allocated to components.

Allocation to systems followed next. The pool of systems loaded to CORE® was derived from Spirals 8 and 10 of MOC System Description documents. Our Capstone team researched each system's capability and allocated functions to appropriate systems. The following sub-sections will describe details of the systems allocation process and results of the gap analysis.

4.2 REQUIREMENTS GENERATION AND ANALYSIS

Figure 4 graphically depicts the six core processes that comprise the actions which fulfill the 44 functions identified in the OV-6c and were assessed by the team. The following paragraphs will discuss the results of the team's assessment.

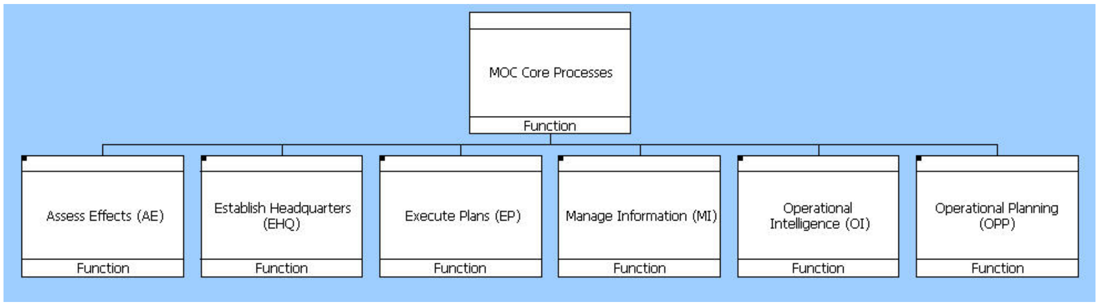

Figure 4 - MOC Core Processes

This figure depicts the six core processes performed by the MOC (U.S. Fleet Forces Command, 2007)

4.2.1 Assess Effects

The MOC Architecture IPT obviously had a difficult task of defining the core processes because the MOC did not follow the normal DoD acquisition process or a disciplined systems engineering development process. Instead, existing U.S. Naval commands were asked to describe how to perform MOC activities. As such, the MOC functions enlisted by the MOC Architecture IPT were simply lists of functions each command's capability needed to effectively synchronize joint maritime operations in planning, execution and assessment of operations. This unorthodox requirement generation method has resulted in several requirement overlaps and some requirement gaps.

The first top-level function analyzed was *Assess Effects*. The Capstone team identified sixteen core processes to address the *Assess Effects* function. Each of these tasks was successfully allocated to available systems.

4.2.2 Operational Intelligence

Using similar method of segregation of MOC functions, our Capstone team identified 102 activities to be associated with *Operational Intelligence* (OPINTEL). These requirements were identified to the best of our team's understanding based on their descriptions and estimates of their capability of meeting a MOC requirement. All 102 were successfully allocated to systems.

4.2.3 Operational Planning

The MOC Operational View (OV-6c) our team received did not provide complete information on what needed to be accomplished and who should be doing it. Requirements for *Operational Planning* were relatively easier to identify as MOC is an operation-centered defense component. There were 112 activities identified to satisfy the *Operational Planning* requirement. One hundred eight of the activities were successfully allocated to systems.

4.2.4 Manage Information

Eighty-five activities were identified that applied to the 5 sub-processes that made up the core process *Manage Information*. The sub-processes that make up the *Manage Information* core process are *Manage Requests for Operational Information, Develop IM Plan, Manage Battle Rhythm, Establish Collaborative Information Environment (CIE),* and *Conduct CND Operations.* Most of the functions within *Manage Information* were successfully allocated to systems. Sixty-nine of the activities were successfully allocated to systems.

4.2.5 Establish Headquarters

Forty-four activities were identified for the core process of *Establish Headquarters*. Of the 44 activities, 39 were traced to systems. The *Establish Headquarters* core process was further refined to *Establish HQ* and *Coordinate Joint Training* sub-processes. Most of the functions under this core process were allocated to the Global Command and Control Systems-Maritime (GCCS-M). Descriptions of these systems are detailed in most of the referenced documents.

4.2.6 Execute Plans

Similarly, 135 functions were identified to be associated to *Execute Plans* core process. 112 of them were successfully traced to systems. Results of the gap analysis on the remainder are discussed in the next section.

4.3 MOC FUNCTIONAL ANALYSIS AND ALLOCATION

As discussed previously, an analysis was performed by the MOC project team to determine whether the functions required by the MOC, identified in the OV-6c, can be fulfilled by current and proposed systems. The MOC Spiral 8 Systems Description document, MOC Spiral 10 Systems Description document, and current systems not identified in the MOC systems documents were considered for the functional allocation analysis.

Using CORE® 5.1.5, the relationship of system to function was quickly established. If there was no system allocated to a function, then the model would graphically depict a GAP component allocated to the function. This indicates that there is no system available that can accomplish the function and a capability gap exists. Figure 5 provides an example of a CORE® graphical depiction of a capability gap. The following section includes excerpts of the tables provided in the Appendix. These excerpts depict examples of the systems assigned to each of the core process activities and any gaps identified.

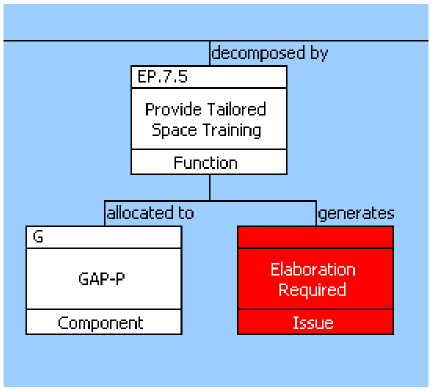

Figure 5 - Capability Gap Depicted in CORE®

This figure illustrates a capability gap with reasoning provided as an Issue

4.3.1 Assess Effects

As seen in Table 8, all functions within the *Assess Effects* core process were allocated to GCCS-M. In addition, 6 of the 16 functions were also allocated to Command and Control PC (C2PC) and 3 were also allocated to the Air Defense System Integrator (ADSI). Overall, 3 functions, *Determine MOEs Achieved, Determine Success or Failure* and *Determine Unintended Effects* were allocated to all 3 systems, GCCS-M, C2PC and ADSI. *Assess Battle Effects, Conduct Weapons Effectiveness Assessment* and *Compare Achieved vs. Desired Results* were allocated to 2 systems, GCCS-M and C2PC. All remaining functions were allocated only to GCCS-M. Although GCCS-M is able to perform all required functions that enable a MOC to continually assess the outcome of operations, a command can still perform functions under the *Assess Effects* core process with C2PC and/or ADSI. This indicates possible capability overlaps. It could also indicate back-up capabilities to accommodate failure or heavy loading of primary systems.

Table 2 - Excerpts of Table 8 Systems Allocated to *Assess Effects* Functions

Functions		**Systems**
AE.1.1	Develop Assessment Plan	GCCS-M
AE.1.2	Assess Achievement of Desired Effects	GCCS-M
AE.1.2.1	Develop Combat Assessment Plan	GCCS-M
AE.1.2.2	Assess Battle Effects	GCCS-M, C2PC
AE.1.2.3	Estimate Initial Damage	GCCS-M

Table 2 (continued)

Functions		Systems
AE.1.2.4	Estimate Functional Damage	GCCS-M
AE.1.2.5	Estimate Ability to Reconstitute	GCCS-M
AE.1.2.6	Conduct Weapons Effectiveness Assessment	GCCS-M, C2PC
AE.1.2.7	Develop Process for Monitoring & Understanding Operational Environment	GCCS-M
AE.1.2.8	Provide Feedback on Operations	GCCS-M

4.3.2 Operational Intelligence

In this section, all available systems that would help determine the critical information a commander requires to understand the flow of operations and to make timely and informed decisions were identified. Systems identified in this section would gather friendly, enemy, and environmental information. A total of 102 tasks were identified to support this core MOC process and all were allocated to one or more systems. Of these processes, 58 were successfully allocated to the Global Command and Control System-Integrated Imagery and Intelligence (GCCS-I3) and GCCS-M systems. Complimentarily, 36 other processes were allocated to the systems Generic Area Limitation Environment (GALE), Joint Service Imagery Processing System (JSIPS), Distributed Common Ground System–Navy (DCGS-N) and Analyst Notebook. Three activities were allocated to the Net-Centric Enterprise Services Collaboration Tool (NCES) and Information Work Space (IWS), and 5 were allocated to Joint Deployable Intelligence Support System (JDISS) and DCGS-N. A more detailed accounting of the systems allocated to each function is listed in Table 9. Functions that have more than one system allocated indicated a possible capability overlap. Details of the gap analysis are documented in the next section.

Table 3 - Excerpts of Table 9 Systems Allocated to *Operational Intelligence* Functions

Functions		Systems
OI.1.1	Review Mission for OPINTEL Needs	GCCS-M, GCCS-I3
OI.1.2	Develop PIRs	GCCS-M, GCCS-I3
OI.1.2.1	Analyze OPLAN, COAs and ECOAs by Phases	GCCS-M, GCCS-I3
OI.1.2.2	Collate Intelligence Required for Operational I&W	GCCS-M, GCCS-I3

Table 3 (continued)

Functions		Systems
OI.1.2.3	Distill Intelligence Requirements	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.2.4	Rank, Prioritize Intelligence Requirements	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.2.5	Determine Intelligence Vital to Mission by Phase of Op	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.3	Identify Intelligence Knowledge Gaps	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.4	Generate RFIs	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.5	Develop Draft Collection Plan	GCCS-M, GCCS-I3

4.3.3 Operational Planning

Our team allocated *Operational Planning* tasks to systems that enable a commander to effectively plan for and execute operations, ensure that the employment of forces is linked to objectives, and integrate naval operations seamlessly with the actions of a joint force. The *Operational Planning* core process was decomposed to 112 activities, 108 were successfully allocated among 25 systems as identified in Table 10. A large number of these tasks were to be accomplished by utilizing Global Combat Support System – Combatant Commander (GCSS-CC/JTF) and Collaborative Force Analysis, Sustainment, and Transportation (CFAST). Figure 6 is a graphical depiction of the number of tasks assigned to each of the systems identified for use in the execution of *Operational Planning.*

The functions that did not have any systems allocated are:

- *Determine Recommended CCIRs*
- *Develop Appropriate Annexes, Appendixes & Tabs*
- *Reconcile Plans and Orders*
- *Back Brief & Crosswalk Orders*

From the analysis conducted by the MOC project team, there does not appear to be a known system that has the capability to fulfill these functions. These are shown as

Capability Gap in the table. Functions that had more than one system allocated to it indicated a possible capability overlap.

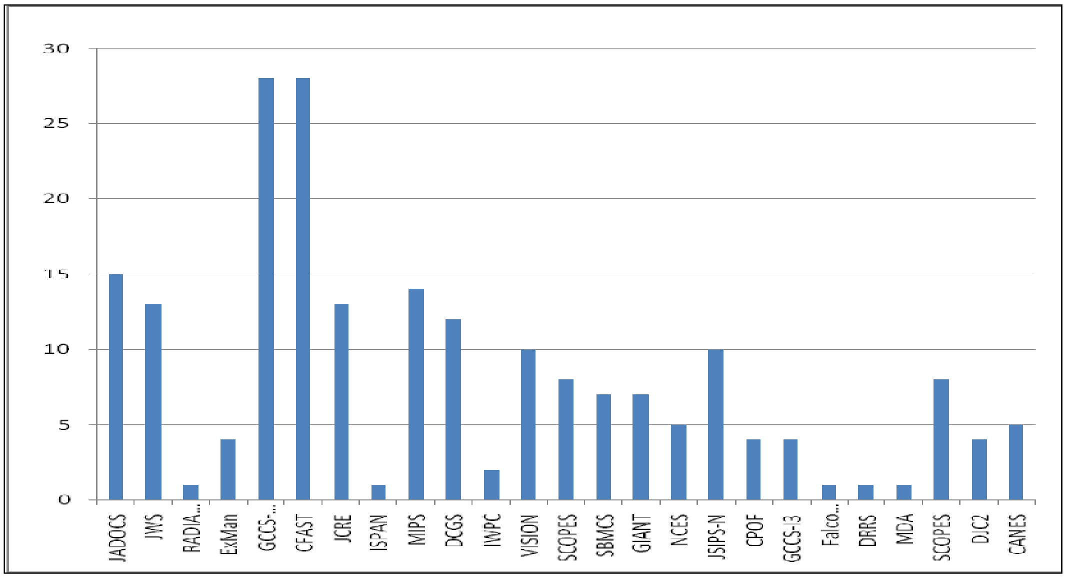

Figure 6 - Operational Planning Tasks allocated to Systems

This figure details the number of activities within the core process assigned to each of the systems determined to provide the needed capability.

Table 4 – Excerpts of Table 10 Systems Allocated to *Operational Planning* Functions

Functions		**Systems**
OPP.1.3	Approve/Modify Mission Statement	JADOCS, JCRE
OPP.1.8	Approve/Modify COA	JCRE, ISPAN
OPP.1.11	Approve Plans/Orders	JCRE
OPP.1.1	Conduct Operational Mission Analysis	MIPS, DCGS
OPP.1.1.1	Analyze Higher Commander's Mission	MIPS, DCGS
OPP.1.1.2	Develop Objectives	MIPS, DCGS
OPP.1.4.2	Determine Recommended CCIRs	**Capability Gap**
OPP.1.10.3	Develop Appropriate Annexes, Appendixes & Tabs	**Capability Gap**
OPP.1.10.6	Reconcile Plans and Orders	**Capability Gap**
OPP.1.10.7	Back Brief & Crosswalk Orders	**Capability Gap**

4.3.4 Manage Information

According to the MOC OV-6c, “Information management, possibly by artificial as well as human agents, would ensure that decision makers have ready access to the information they want and need while minimizing the risk of information overload.” To this end, 6 sub-processes were identified and further refined into 85 tasks. Our team successfully allocated these tasks among 30 systems. As shown in Figure 7, the Consolidated Afloat Networks and Enterprise Services (CANES) accomplishes 10 of these tasks; however, it is clear that diverse information gathering, filtering or analysis systems would have to be deployed in order to accomplish all required tasks under *Manage Information*.

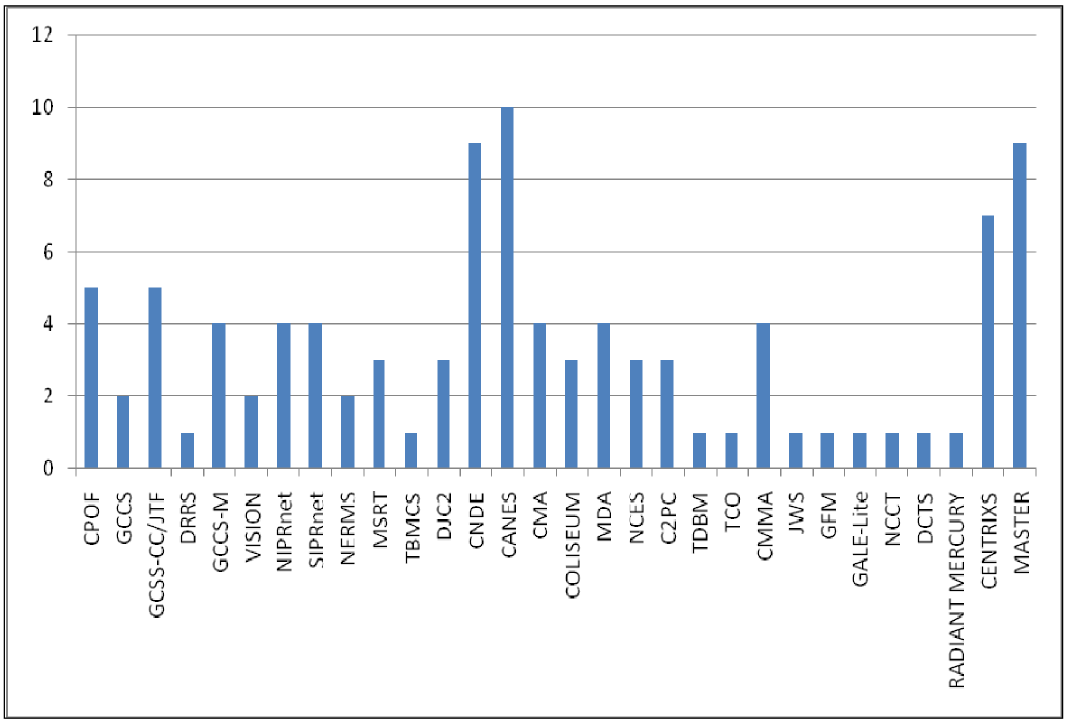

Figure 7 - Number of *Manage Information* Activities allocated to Systems

This figure details the number of activities within the core process assigned to each of the systems determined to provide the needed capability.

The *Manage Information* core process was decomposed to 84 activities of which 66 were allocated to one or more systems. The system(s) allocated to each function can be found in Table 11.

The functions that did not have any systems allocated are listed here and assigned "Capability Gap" in the systems column in Table 11:

- *Ensure Authorized Entities & Information Used*
- *Adapt info Sharing to Accommodate Evolving Needs*
- *Manage Information Management Cell*
- *Manage Workgroup Managers (embedded/shared)*
- *Manage Electronic File Plan*
- *Manage Suspense Control*
- *Provide Component IM Cell Services*
- *Develop Data/Information*
- *Determine Information Pedigree*
- *Maintain Information Pedigree*
- *Establish Digital Rules of Protocol*
- *Identify Subscription*
- *Request Subscription*
- *Evaluate Subscribed Data/Information*
- *Update Subscription*
- *Formulate Discovery Search*
- *Coordinate IMP*
- *Provide Computer Network Defense Services*

From the analysis done by the MOC project team, there does not appear to be a known system that has the capability to fulfill these functions. These are shown as **Capability Gap** in the table. Functions that had more than one system allocated indicated a possible capability overlap.

Table 5 - Excerpt of Table 11 Systems Allocated to *Manage Information* Functions

Functions		**Systems**
MI.1.1	Ensure Authorized Entities & Information Used	**Capability Gap**

Table 5 (continued)

Functions		Systems
MI.1.2	Adapt info Sharing to Accommodate Evolving Needs	**Capability Gap**
MI.1.3	Manage Information Management Cell	**Capability Gap**
MI.1.3.1	Manage Workgroup Managers (embedded/shared)	**Capability Gap**
MI.1.3.2	Provide Overall Info-Related Admin Support	MSRT
MI.1.3.3	Manage Electronic File Plan	**Capability Gap**
MI.1.3.4	Manage Messaging Services	TBMCS, DJC2
MI.1.3.5	Manage Suspense Control	**Capability Gap**
MI.1.3.6	Provide Component IM Cell Services	**Capability Gap**
MI.1.4	Provide/Publish Data/Information to Net-Centric Environment	CNDE, CANES

4.3.5 Establish Headquarters

The *Establish Headquarters* core process was decomposed to 44 activities, 43 of which were allocated to at least one or more systems. The system(s) allocated to each function can be found in Table 12. The majority of the activities could be accomplished by the GCCS systems. Other systems, such as the Global Combat Support System (GCSS) and Deployable Joint Command and Control (DJC2), also fulfilled some of the activities allocated to the GCCS systems.

The activity that did not have any systems allocated is:

- *Sub Component Interagency*

It was determined that this activity would not be performed by MHQ w/MOC. This is shown as a **Capability Gap** in the table. Activities that had more than one system allocated to it indicated a possible capability overlap.

Table 6 - Excerpts of Table 12 Systems Allocated to *Establish Headquarters* Functions

Functions		Systems
EHQ.1.1	Establish Appropriate Organizational Relationships	GCCS-M
EHQ.1.6	Connect & Interface with Non-DoD Organizations	GCCS-M
EHQ.1.7	Establish Role-Based Knowledge Framework	GCCS-M
EHQ.1.8	Form Distributed Teams/COIs/CofP	GCCS-M, GCSS

Table 6 (continued)

Functions		Systems
EHQ.1.8.1	Access Subject Matter Expert & Essential Information	GCCS-M, GCSS
EHQ.1.8.2	Identify COI/CofP	GCCS-M
EHQ.1.8.3	Establish COI/CofP	GCCS-M
EHQ.1.8.4	Develop COI/CofP Charter	GCCS-M
EHQ.1.8.5	Prioritize Information Sharing Capabilities	GCCS-M, GCSS
EHQ.1.11	Sub Component Interagency	**Capability Gap**

4.3.6 Execute Plans

The *Execute Plans* core process was decomposed to 135 activities; of which 119 were allocated to one or more systems. The system(s) allocated to each activity can be found in Table 13.

The activities that did not have any systems allocated are:

- *Administratively & Clinically Validate Patient*
- *Provide Patient Attendants & Movement Items*
- *Move Patient*
- *Conduct Patient Evacuation*
- *Provide Headquarters Personnel & Infrastructure*
- *Provide Augmentation*
- *Provide for Personnel Services*
- *Process JIP TL/JIP CL/Asset Appointment*
- *Provide Tailored Space Training*
- *Develop/Maintain Logistics Base in JOA*
- *Predict Repair/Maintenance Requirements*
- *Sense Repair/Maintenance Requirements*
- *Configure Netted Sensor Grid*
- *Task Sensor*
- *Conduct Dynamic Cross-Cuing of Sensor Data*
- *Provide Sensor Tip-Off*

From the analysis done by the MOC project team, there does not appear to be a known system that has the capability to fulfill these functions. This is shown as **Capability Gap** in the table. Activities that had more than one system allocated to it indicated a possible capability overlap.

Table 7 - Excerpts of Table 13 Systems Allocated to *Execute Plans* Functions

Functions		Systems
EP.3.6.1	Administratively & Clinically Validate Patient	**Capability Gap**
EP.3.6.6	Provide Patient Attendants & Movement Items	**Capability Gap**
EP.3.6.7	Move Patient	**Capability Gap**
EP.3.7	Conduct Patient Evacuation	**Capability Gap**
EP.5.4	Provide Headquarters Personnel & Infrastructure	**Capability Gap**
EP.5.4.3	Provide Augmentation	**Capability Gap**
EP.5.7	Provide for Personnel Services	**Capability Gap**
EP.6.15	Process JIP TL/JIP CL/Asset Appointment	**Capability Gap**
EP.7.5	Provide Tailored Space Training	**Capability Gap**
EP.9.2	Develop/Maintain Logistics Base in JOA	**Capability Gap**
EP.9.8.1	Predict Repair/Maintenance Requirements	**Capability Gap**
EP.9.8.2	Sense Repair/Maintenance Requirements	**Capability Gap**
EP.10.2	Configure Netted Sensor Grid	**Capability Gap**
EP.10.3	Task Sensor	**Capability Gap**
EP.10.4.3	Conduct Dynamic Cross-Cuing of Sensor Data	**Capability Gap**
EP.10.4.4	Provide Sensor Tip-Off	**Capability Gap**

4.4 VERIFICATION AND VALIDATION

Once all the relevant data (documents, requirements, functions, systems, etc.) had been compiled, the relationships were established as described in Section 4.3. The next phase of the project involved populating the model in CORE® 5.1.5. The CORE® software uses a model-based systems engineering (MBSE) approach for system and architecture development. For the purpose of this project, the CORE® software was used establish traceability from the MOC CONOPS and other documents to the functions and systems. The ultimate goal was to generate graphical views to allow the users to easily identify the MOC capability gaps and possible overlaps.

The Systems Engineering (SE) schema in CORE® was used to build the model. The SE schema provided the classes, relationships, and attributes necessary to establish the traceability for the MOC project. Figure 8 provides an overview of the classes and relationships that can be established. Not all of the available class relationships were included in the figure for clarity. Additional classes were used in the MOC project, including Issue, Document, and Category.

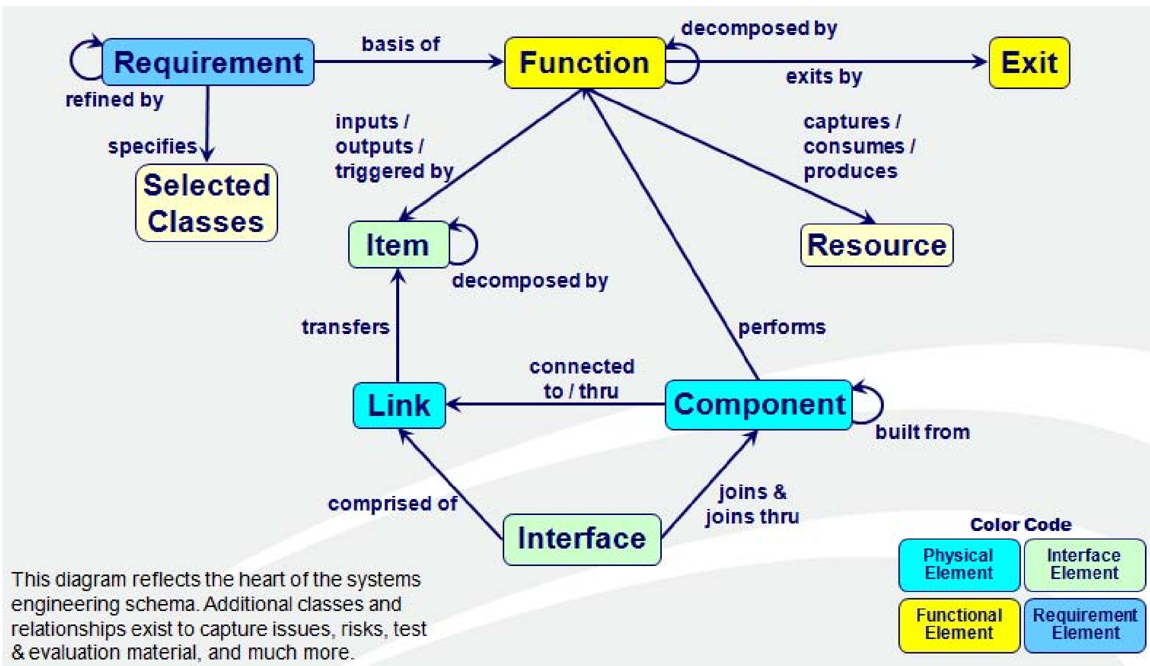

Figure 8 - Overview of Class Relationships Established in CORE®

This diagram reflects the heart of the systems engineering schema. Additional classes and relationships exist to capture issues, risks, test & evaluation material, and much more. (Vitech Corporation, 2005)

4.4.1 Populating CORE®

The MOC CONOPS and DODAF artifacts (SV-4a, SV-5a, SV-8, and OV-6c) were the primary sources of data for populating the CORE® model. Populating the model was expedited with the aid of the Element Extractor feature in CORE®. The Element Extractor allows the user to quickly populate the CORE® model from existing documents. The relevant documents were first loaded to the Element Extractor. The user then selected text from the document and chose a field in the Element Definition window to be populated. Attributes not available in the documents had to be entered manually. Figure 9 shows the Element Extractor being used to extract text from the MOC Spiral 10 Systems Description document.

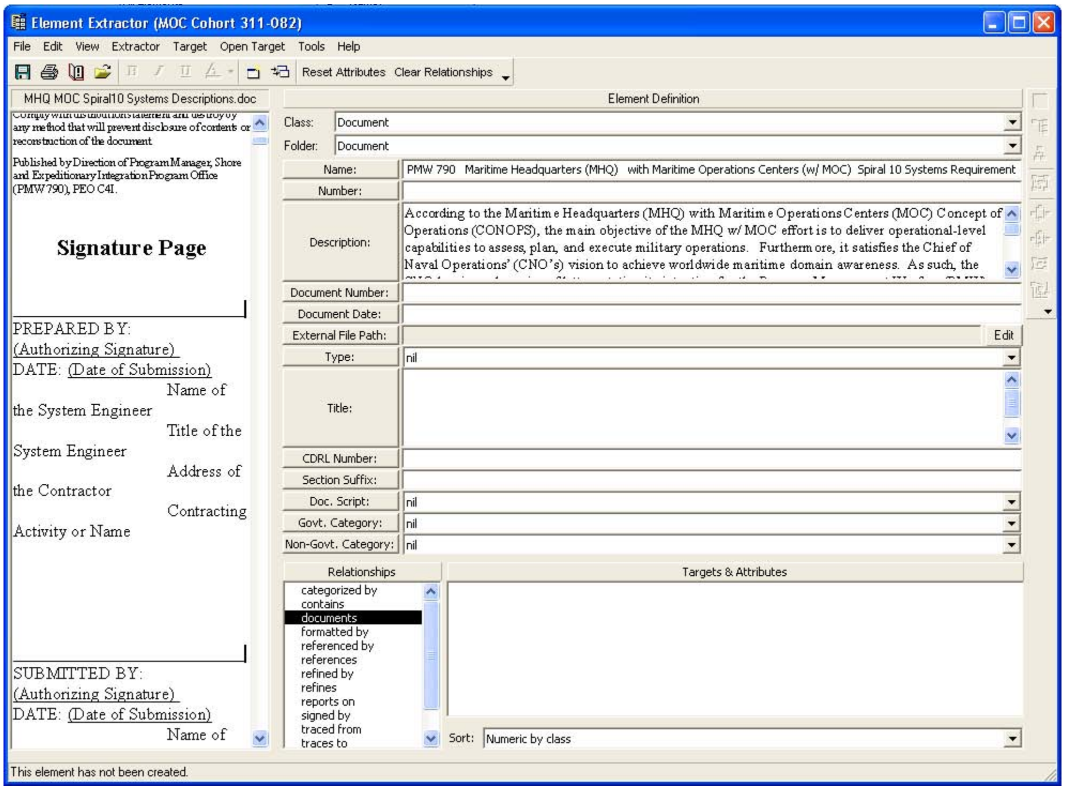

Figure 9 - CORE® Element Extractor

Captures relevant information from references to associate with individual elements

Data was extracted to elements of different classes. As shown in Figure 10, only 7 of the SE schema classes were used for the MOC project. The Category class contains Assess, Plan, and Execute elements to which all the requirements are categorized. The Component class contains the systems elements. The Document class contains the document elements. The Function class contains the functions the MOC is required to perform. The Issue class contains the issue elements, which are allocated to functions if an issue requiring future action is identified. The Item class contains the UJTL task elements. The Requirement class contains the requirement elements drawn from governing documentation.

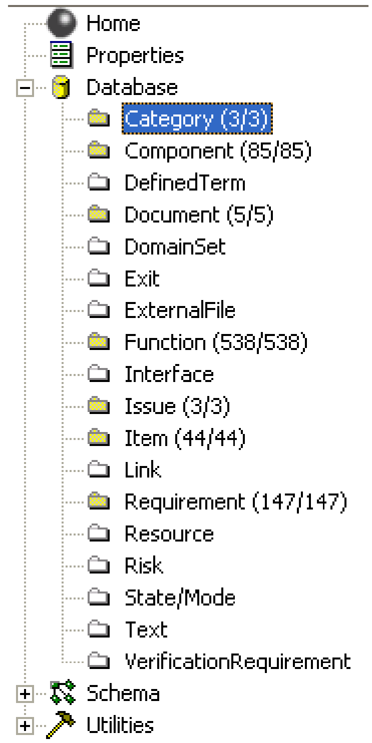

Figure 10 - CORE® SE Classes

4.4.2 Establishing Relationships

Relationships can be established between elements of different classes and elements of the same class. This can be accomplished by selecting the appropriate type of relationship in the Relationships field as shown in Figure 11.

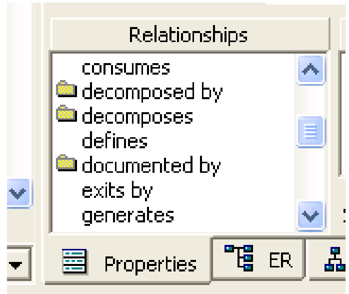

Figure 11 - Relationships

This figure illustrates relationships between elements of different classes or of the same class.

Figure 12 shows some of the key types of relationships allowed in the CORE® SE schema. Additional relationship types not shown in the figure, such as *generate* and *generated by*, were used to tie issues to functions. If a function element does not have a component allocated, an Issue element is generated. Not all of the relationships were used for the MOC project.

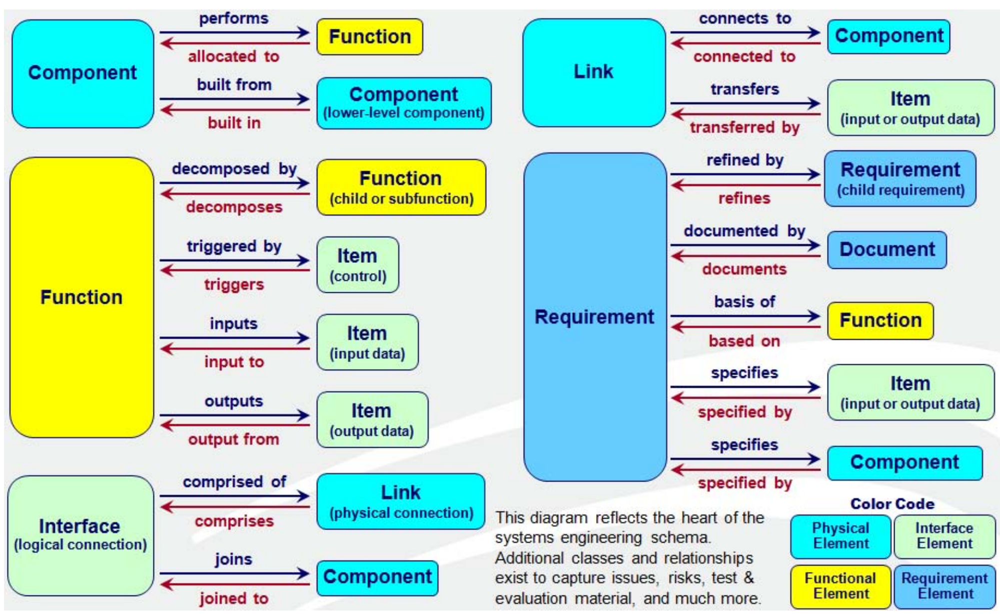

Figure 12 - Key SE Relationships

This diagram reflects the heart of the systems engineering schema. (Vitech Corporation, 2007)

For the MOC project, the following relationships were established:

- Category *categorizes* Requirement
- Requirement *refines* Requirement
- Function *allocated to* Component
- Function (sub-function) *decomposes* Function
- Function *generates* Issue
- Document *documents* Function, Requirement, Component

Relationships always exist in both directions; however, only one relationship needs to be established by the user. Once a relationship is established from one element, CORE® will automatically establish the relationship from the other element. For example, if an *allocated to* relationship is established from the Function element to the Component element, CORE® will establish a *performs* relationship from the Component element to the Function element.

4.4.3 Generating Views

The effectiveness of using CORE® for the MOC project is realized by the different views that can be generated. While there are many views and DODAF artifacts that can be generated from CORE®, the MOC project focuses primarily on two, the Element Relationship (ER) diagrams and the hierarchy diagrams. The ER diagram for an element displays all the direct relationships linked to that element. Two examples of ER diagrams are shown in Figure 13 and Figure 14. Figure 13 shows that the Falconview system *performs* Plan Evacuation Route and Develop Base Paragraphs for Operation Plans & Orders functions. Figure 14 shows that the Provide In-transit Patient Visibility function is *allocated to* four systems, possibly indicating capability overlaps. It also *decomposes* the Coordinate Patient Movement function, indicating that it is a child activity to that function.

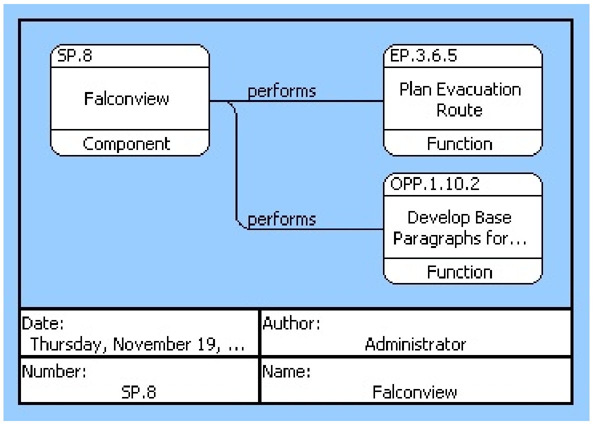

Figure 13 - Element Relationship Diagram of the Falconview Component

This diagram depicts the activities to which the Falconview system is allocated

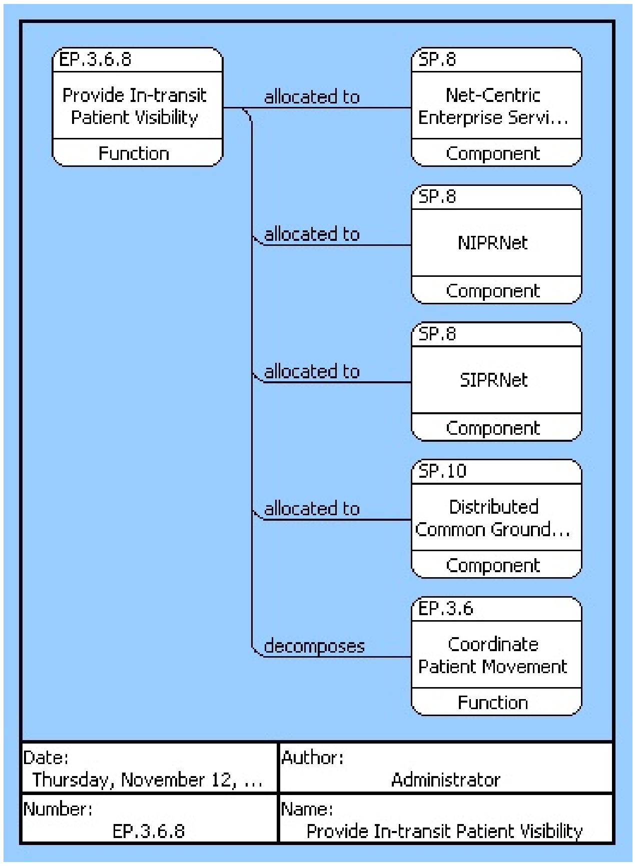

Figure 14 - Element Relationship Diagram

This diagram identifies which systems have been allocated to accomplish the assigned activity.

Customizable hierarchy diagrams can also be generated, showing traceability from high level functions to individual systems. Figure 15 shows a partial view of the hierarchy diagram for the *Assess Effects* core process. As shown in the figure, the *Assess Effects* core process was decomposed to sub-functions by two levels. Those sub-functions were allocated to one or more systems. The types of relationships are also displayed.

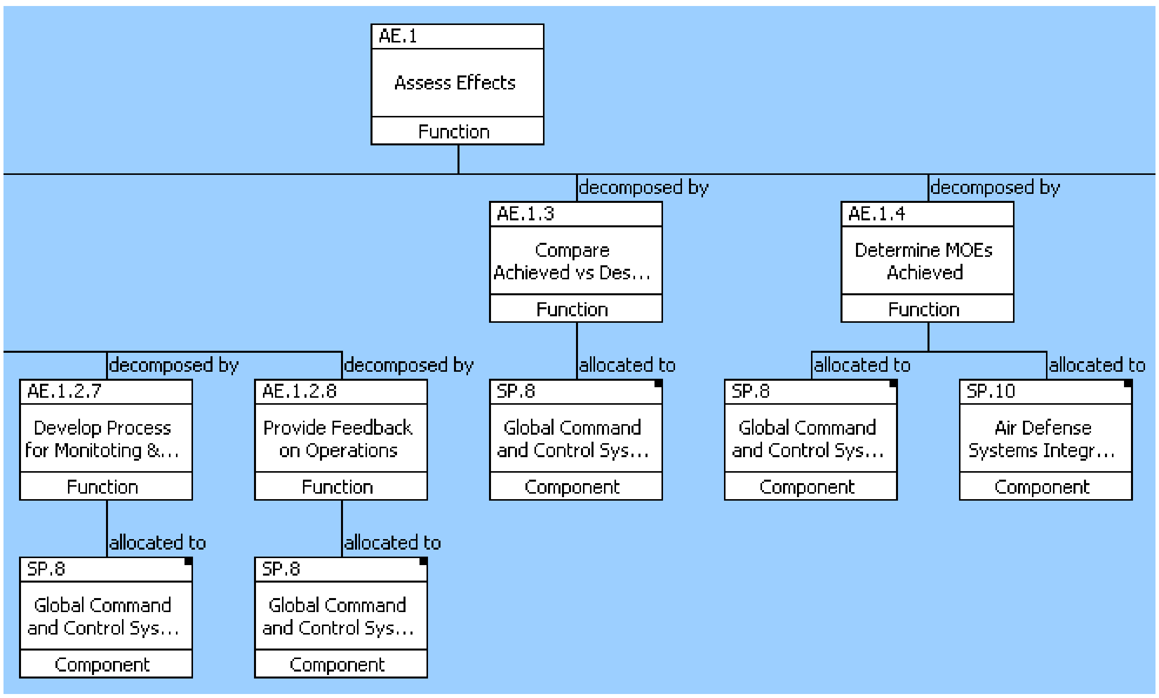

Figure 15 - Partial View of traceability
This diagram illustrates the traceability provided by CORE®

4.4.4 Validation

The views generated by CORE® graphically display the MOC capability gaps and overlaps. If the determination was made that no system can fulfill a function, a GAP component element was allocated to the function. In Figure 16, the hierarchy diagram shows a GAP component *allocated to* the function. In addition to the GAP component, an Issue element was generated, identifying a possible issue with the function. If multiple systems were allocated to a function, as shown in Figure 17, then a possible capability overlap was indicated.

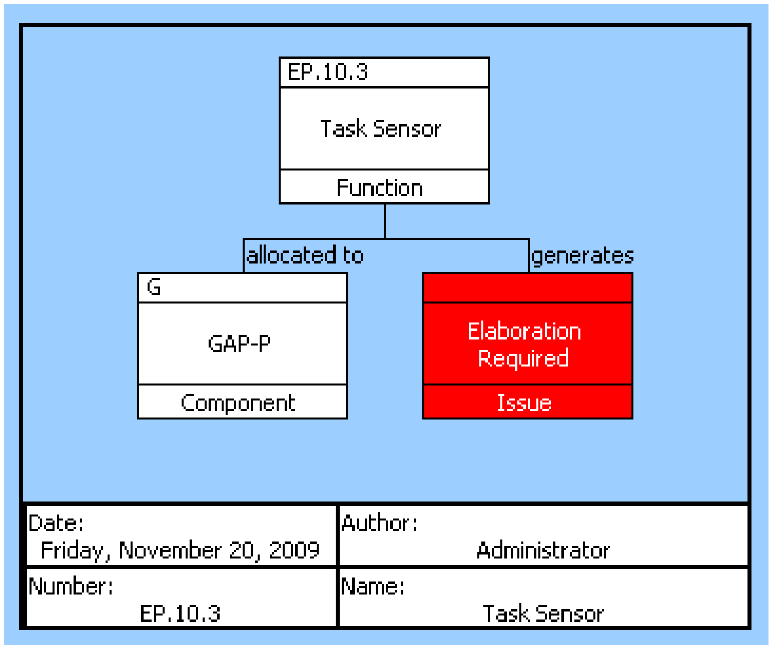

Figure 16 - Capability Gaps in the CORE® Model

This figure illustrates a capability gap with reasoning assigned as an Issue

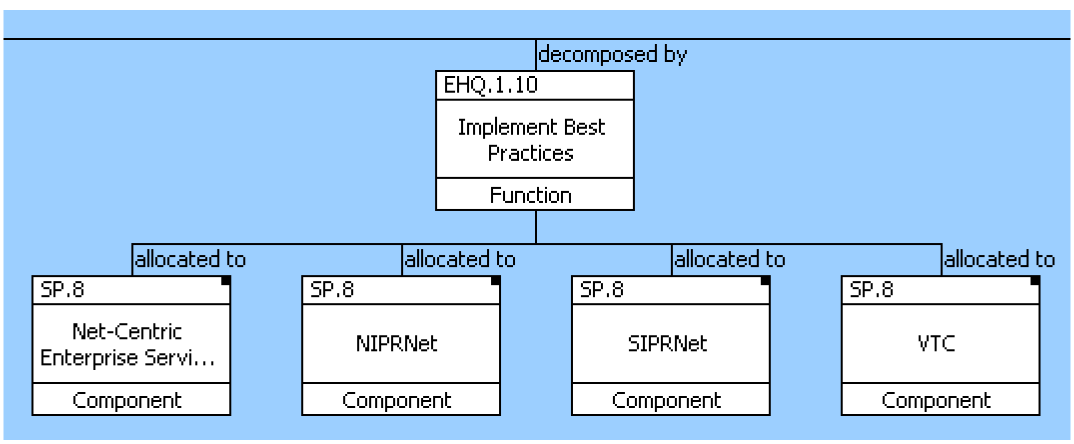

Figure 17 - Capability Overlaps in the CORE® Model

This illustrates multiple systems assigned to a single activity

Modeling with requirements software allowed for quick identification of gaps and traceability to core processes. As new systems become available to fill those gaps the model can be updated and the effects of those changes easily identified. Additionally, analysis of the revised model will identify capability overlaps.

4.4.5 Challenges of Using CORE®

While the CORE® software provided the traceability necessary for the MOC project, it is not without its challenges, and there were several encountered when using CORE® for this project. Since none of the team members were familiar with the software, there was a steep learning curve involved. This issue was overcome by completing the CORE® AutoLink guided tour to gain familiarity with CORE® MBSE approach. Since the capstone project was time bounded, the extra effort expended to become familiar with the software put a strain on the project.

Limited access to CORE® also posed a challenge. The software was only available through the NPS Virtual SE lab, limiting access to those with World Wide Web access. The software does not have the capability for real-time collaboration with multiple users, slowing the progress of populating the model. Only one user could work on the data file at a given time. A situation involving the licensing of CORE® made the software inaccessible for 14 days at the beginning of the third quarter of the Capstone project. During that time, work continued utilizing Microsoft Excel to establish the relationships.

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5 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 SUMMARY

The goal of this project was to identify and implement a methodology for conducting an analysis of the operational capabilities of the Maritime Operations Centers (MOCs) based on assigned baseline systems in order to determine if the capabilities present would be sufficient to execute the mission assigned successfully. The methodology selected involved the use of requirements analysis software for modeling and analysis of data extracted from MOC documentation obtained from various sources, with emphasis on traceability to requirements. The analysis was completed and, based on the information available, a conclusion was reached that gaps exist in the functional capabilities of the MOC; therefore preventing the ability to successfully accomplish all assigned missions.

5.2 CONCLUSIONS

As stated in the summary, it was determined that several capability gaps exist if only the currently planned systems are available in the MOC. The systems assessed were identified in the Spiral 8 and Spiral 10 baseline memoranda released by the office of the Director for Warfare Integration (N6F). Additional systems were being identified for the Spiral 12 build concurrently with this analysis, but a definitive list of systems was not available for inclusion in this analysis.

5.2.1 Requirements

Requirements traceability was the foundation of the analysis conducted. However, because the available requirements for the MOC were inconsistent in places and were not validated, the analysis of capabilities was limited. The requirements to which system capabilities were compared were drawn from governing documentation, but were partially “inferred” by the project team. This was possible because involvement with various MOC working groups and IPTs allowed team members to become familiar with the MOC development efforts that had occurred prior to commencing the project. Some supporting documentation was available, but configuration management appeared not to have been implemented in most cases. No formal documentation of requirements has been produced (as confirmed by the SPAWAR Technical Authority department) and many of the documents used to create the supporting architecture views have been drafts. It is unclear if the draft documents can be considered definitive or whether there are changes that have not yet been reflected in them. At the time this analysis was completed, neither updated versions of requirements documents nor architecture descriptions have been located.

5.2.2 Gaps

Of the six core processes that comprise the MOC functional mission areas (*Assess Effects, Operational Intelligence, Operational Planning, Manage Information, Establish HQ,* and *Execute Plans)*, two were assessed to be fully-mission capable using current and proposed systems: *Assess Effects* and *Operational Intelligence.* The remaining four had a total of 37 gaps in the required capabilities. In some cases, the term "gap" could imply that insufficient information was available to determine which system should be assigned to accomplish the activity; therefore it was not possible to determine if the required capability existed. Other instances were attributed to the appropriateness of the level in the chain of command associated with the activity descriptions. Some functions appeared to be tactical in nature and the team concluded it would be inappropriate for a command and control organization to execute them. Each of these situations resulted in assignment as a "potential gap." In cases where team members determined that none of the systems present were capable of completing the required tasks, a "true gap" resulted.

A limitation of this study was the team's lack of hands-on experience with some of the relevant systems. The number of potential gaps identified in this analysis illustrates the need for subject matter expert involvement. The assignment of systems in this analysis was based on available system descriptions and the individual's interpretation of each activity that comprised the core processes. Descriptions of systems were taken at face value without questioning whether they were optimistic or not. Experts more familiar with the proposed systems might find more gaps than those identified by the team. They might also be able to reclassify potential gaps as true gaps. Despite this limitation, the methodology applied by the team is sound and will facilitate future efforts.

5.3 RECOMMENDATIONS

5.3.1 Requirements

The most important recommendation generated as a result of our project is for the Navy to review and refine the MOC requirements and validate a formal requirements document. Requirements are the cornerstone of the systems engineering process (Buede, 2000). The success of any efforts in the development of an acquisition program hinges on requirements. It is impossible to determine if the appropriate capabilities are present if requirements that define the functionality to be achieved are incomplete or inconsistent.

5.3.2 Use of Software

A significant recommendation for a program development of this size is to incorporate the use of requirements software. During the development of the MOC concept, the number of functions being considered as relevant or necessary by the working group exceeds 1,000 and continues to grow. The use of spreadsheets to capture and analyze a collection of this magnitude is inefficient and contributes to human error when implementing practices such as configuration management, traceability, and the determination of effects caused by changing the elements within the system. The ability to establish relationships between each element and identify traceability to requirements ensures the appropriate functionality is maintained and the effects of changing system components can be identified and mitigated. The subject of interoperability was briefly discussed in this report, but due to the complexity of system interfaces it was not incorporated into the analysis. These interfaces can also be identified and established with the help of the automation software. This will ensure interoperability is taken into consideration and the effects identified prior to incorporating changes to system composition.

5.3.3 Use of DoDAF Schema

Utilizing a modified approach to the analysis could provide the desired gap analysis as well as additional benefits. The use of the DoDAF schema would provide a more suitable foundation for creating a detailed information architecture and a functional model of the MOC network. The effort would still utilize the tasks that comprise the UJTLs, mapping them to operational activities and subsequently establishing relationships to functions and systems. Identification of the relationships between the activities and the MOC organizational entities responsible for each action would complete the information flow model. Analysis of this model would also provide the ability to determine any shortfalls in the necessary functionality.

5.3.4 Incorporation into Spiral 12

The final recommendation is to incorporate this methodology into the current spiral (12) development of the MOC. Doing so would provide visibility of potential shortfalls in the work conducted to date while providing a structured approach to future development efforts. Validation of requirements will prevent extraneous effort while helping to provide focus in the MOC development where needed.

APPENDIX A
DETAILED LISTS OF SYSTEMS SYSTEM ASSIGNMENTS

The tables below identify functional task identifiers, short descriptors, systems assigned, and gaps where system assignment was not possible.

Table 8 - Systems Allocated to *Assess Effects* Functions

Functions		**Systems**
AE.1.1	Develop Assessment Plan	GCCS-M
AE.1.2	Assess Achievement of Desired Effects	GCCS-M
AE.1.2.1	Develop Combat Assessment Plan	GCCS-M
AE.1.2.2	Assess Battle Effects	GCCS-M, C2PC
AE.1.2.3	Estimate Initial Damage	GCCS-M
AE.1.2.4	Estimate Functional Damage	GCCS-M
AE.1.2.5	Estimate Ability to Reconstitute	GCCS-M
AE.1.2.6	Conduct Weapons Effectiveness Assessment	GCCS-M, C2PC
AE.1.2.7	Develop Process for Monitoring & Understanding Operational Environment	GCCS-M
AE.1.2.8	Provide Feedback on Operations	GCCS-M
AE.1.3	Compare Achieved vs Desired Results	GCCS-M, C2PC
AE.1.4	Determine MOEs Achieved	GCCS-M, ADSI, C2PC
AE.1.7	Determine Success or Failure	GCCS-M, ADSI, C2PC
AE.1.8	Aggregate Effects Assessment	GCCS-M
AE.1.5	Determine Unintended Effects	GCCS-M, ADSI, C2PC
AE.1.6	Identify and Assess Implications of Unintended Effects	GCCS-M

Table 9 - Systems Allocated to *Operational Intelligence* Functions

Functions		**Systems**
OI.1.1	Review Mission for OPINTEL Needs	GCCS-M, GCCS-I3
OI.1.2	Develop PIRs	GCCS-M, GCCS-I3
OI.1.2.1	Analyze OPLAN, COAs and ECOAs by Phases	GCCS-M, GCCS-I3
OI.1.2.2	Collate Intelligence Required for Operational I&W	GCCS-M, GCCS-I3
OI.1.2.3	Distill Intelligence Requirements	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.2.4	Rank, Prioritize Intelligence Requirements	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.2.5	Determine Intelligence Vital to Mission by Phase of Op	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.3	Identify Intelligence Knowledge Gaps	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.4	Generate RFIs	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.5	Develop Draft Collection Plan	GCCS-M, GCCS-I3
OI.1.5.1	Manage Collection, Intelligence Requirements	GCCS-M, GCCS-I3
OI.1.5.1.1	Identify Collection Requirements	GCCS-M, GCCS-I3
OI.1.5.1.2	Validate Collection Requirement	GCCS-M, GCCS-I3

Table 9 - Systems Allocated to *Operational Intelligence* Functions (continued)

Functions		**Systems**
OI.1.5.1.3	Prioritize & Integrate Collection Requirements	GCCS-M, GCCS-I3
OI.1.5.1.4	Forecast Available Collection Assets	GCCS-M, GCCS-I3
OI.1.5.1.5	Forward CR to Next Higher Echelon	GCCS-M, GCCS-I3
OI.1.5.4	Synchronize ISR with Operations	GCCS-M, GCCS-I3
OI.1.5.9	Visualize ISR Coverage of the Operational Environment	GCCS-M, GCCS-I3
OI.1.5.2	Provide Collection Strategy	GCCS-M, GCCS-I3
OI.1.5.2.1	Establish Intelligence Collection Deadlines	GCCS-M, GCCS-I3
OI.1.5.2.2	Develop Collection Strategy	GCCS-M, GCCS-I3
OI.1.5.2.3	Determine Friendly ISR Forces/Capability (Organic)	GCCS-M, GCCS-I3
OI.1.5.2.4	Prioritize ISR Options	GCCS-M, GCCS-I3
OI.1.5.2.5	Select ISR Option	GCCS-M, GCCS-I3
OI.1.5.2.6	Aggregate Elements of Collection Strategy	GCCS-M, GCCS-I3
OI.1.5.3	Provide Draft ISR Synchronization Matrix	GCCS-M, GCCS-I3
OI.1.5.5	Finalize ISR Synchronization Matrix	GCCS-M, GCCS-I3
OI.1.5.6	Develop Draft Collection Plan	GCCS-M, GCCS-I3
OI.1.5.6.1	Update NAIs & Event Template	GCCS-M, GCCS-I3
OI.1.5.6.2	Confirm Asset/Sensor Availability	GCCS-M, GCCS-I3
OI.1.5.6.3	Update Environmental Information	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.5.6.4	Refine/Revise Multi-INT Collection Plan	GCCS-M, GCCS-I3
OI.1.5.6.5	Generate Asset/Sensor/Placement/Route	GCCS-M, GCCS-I3
OI.1.5.6.6	Apply Airspace/Waterspace Management Procedures	GCCS-M, GCCS-I3
OI.1.5.6.7	Aggregate Elements of Collection Plan	GCCS-M, GCCS-I3
OI.1.5.8	Approve Collection Plan	NCES; IWS
OI.1.5.7	Coordinate Collection Plan	GCCS-M, GCCS-I3
OI.1.6	Process/Exploit BA/ISR Data	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.6.1	Interpret Sensor Data	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.6.2	Place Raw Data into Context	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.6.3	Collate BA/ISR Data	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.6.4	Correlate BA/ISR Data	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.6.5	Fuse ISR Data	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.7	Process & Exploit Collected Information	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.7.1	Process Operational Environment Information Distributively	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.7.2	Integrate Operational Environment Awareness Information	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.7.3	Evaluate Operational Environment Information	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.7.4	Interpret Operational Environment Information	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.7.5	Fuse Information	GALE, JSIPS, Analyst Notebook, DCGS-N

Table 9 - Systems Allocated to *Operational Intelligence* Functions (continued)

Functions		Systems
OI.1.7.6	ShareFused Information	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.8	Analyze Operational Environment Information	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.9	Update IPOE	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.1.10	Conduct Predictive Analysis	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.1	Define the Environment	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.1.1	Identify Limits of Component Commander's Area of Operations	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.1.2	Determine Significant Characteristics of Operational Area	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.1.3	Establish Limits of Force's Areas of Interest	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.1.4	Determine Full Spectrum of Force's Environment	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.1.5	Determine Environment Detail Required	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.2	Analyze the Environment	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.2.1	Analyze Military Aspects of Each Dimension	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.2.2	Evaluate Effects of Each Environment Dimension on Military Operations	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.2.3	Evaluate Existing Databases & Identify Intel Gaps & Priorities	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.2.4	Collect Material & Intelligence Required	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.2.5	Confirm Area/Country Studies	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.3	Analyze Commander Intent & Guidance	GCCS-M, GCCS-I3
OI.2.4	Analyze CCIR	GCCS-M, GCCS-I3
OI.2.5	Evaluate the Adversary (Phase 1)	GCCS-M, GCCS-I3
OI.2.5.1	Identify Adversary Centers of Gravity	GCCS-M, GCCS-I3
OI.2.5.2	Identify Adversary Objectives & Desired End State	GCCS-M, GCCS-I3
OI.2.5.3	Analyze Centers of Gravity (Phase 1)	GCCS-M, GCCS-I3
OI.2.5.4	Update or Create Adversary Models (Phase 1)	GCCS-M, GCCS-I3
OI.2.5.5	Identify Adversary Courses of Action	GCCS-M, GCCS-I3
OI.2.5.6	Determine Current Adversary Situation	GCCS-M, GCCS-I3
OI.2.5.7	Determine What I&W Would Point Toward Likely Adversary COA	GCCS-M, GCCS-I3
OI.2.5.8	Identify Adversary Capabilities	GCCS-M, GCCS-I3
OI.2.5.9	Update Adversary Patterns of Behavior	GCCS-M, GCCS-I3
OI.2.6	Develop Each Adversary COA	GCCS-M, GCCS-I3
OI.2.6.1	Select Adversary Model Representative of Considered Military Ops	GCCS-M, GCCS-I3
OI.2.6.2	Overlay Doctrinal Template on the MCOO	GCCS-M, GCCS-I3
OI.2.6.3	Adjust Dispositions to Account for Environment Effects	GCCS-M, GCCS-I3

Table 9 - Systems Allocated to *Operational Intelligence* Functions (continued)

Functions		**Systems**
OI.2.6.4	Depict Location & Activities of all HVTs in Adversary Model	GCCS-M, GCCS-I3
OI.2.6.5	Analyze& Wargame Adversary's Likely Scheme of Maneuver	GCCS-M, GCCS-I3
OI.2.6.6	Refine & Re-evaluate HVTs	GCCS-M, GCCS-I3
OI.2.6.7	Designate Target Areas of Interest (TAIs)	GCCS-M, GCCS-I3
OI.2.7	Evaluate & Prioritize Each Adversary COA	GCCS-M, GCCS-I3
OI.2.7.1	Identify Adversary COA Strengths & Weaknesses, COGs & Decisive Points	GCCS-M, GCCS-I3
OI.2.7.2	Evaluate How Well Adversary COA Meets Established Criteria	GCCS-M, GCCS-I3
OI.2.7.3	Evaluate How Well Adversary COA Takes Advantage of Environment	GCCS-M, GCCS-I3
OI.2.7.4	Determine Which COA Offers Greatest Advantage & Minimal Risk	GCCS-M, GCCS-I3
OI.2.7.5	Consider Adversary May Select Other COA	GCCS-M, GCCS-I3
OI.2.7.6	Analyze Adversary Activity to Determine if a COA Selected	GCCS-M, GCCS-I3
OI.2.7.7	Identify Adversary Preparations	GCCS-M, GCCS-I3
OI.2.8	Identify Initial Collection Requirements	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.2.9	Prepare & Submit IPOE Products	GALE, JSIPS, Analyst Notebook, DCGS-N
OI.3.1	Develop Procedures for RFI Submission	NCES; IWS
OI.3.2	Develop Feedback Mechanism	NCES; IWS
OI.3.3	Validate RFI	JDISS, DCGS-N
OI.3.4	Submit RFI to HHQ	JDISS, DCGS-N
OI.3.5	Answer RFI	JDISS, DCGS-N
OI.3.6	Track RFIs	JDISS, DCGS-N
OI.3.7	Report RFI Status	JDISS, DCGS-N

Table 10 - Systems Allocated to *Operational Planning* Functions

Functions		**Systems**
OPP.1.3	Approve/Modify Mission Statement	JADOCS, JCRE
OPP.1.8	Approve/Modify COA	JCRE, ISPAN
OPP.1.11	Approve Plans/Orders	JCRE
OPP.1.1	Conduct Operational Mission Analysis	MIPS, DCGS
OPP.1.1.1	Analyze Higher Commander's Mission	MIPS, DCGS
OPP.1.1.2	Develop Objectives	MIPS, DCGS
OPP.1.1.3	Determine Specified, Implied, Essential Tasks	MIPS, DCGS
OPP.1.1.4	State the Purpose	MIPS, DCGS
OPP.1.1.5	Identify Externally Imposed Limitations	MIPS, DCGS
OPP.1.1.6	Analyze Available Forces and Assets	MIPS, DCGS
OPP.1.1.7	Determine Critical Factors, COGs, & Decisive Points	IWS, VISION
OPP.1.1.8	Develop Planning Assumptions	MIPS, DCGS
OPP.1.1.9	Conduct Initial Risk Assessment	MIPS, DCGS
OPP.1.1.10	Develop Proposed Mission Statement	MIPS, DCGS

Table 10 - Systems Allocated to *Operational Planning* Functions (continued)

Functions		**Systems**
OPP.1.1.11	Prepare Mission Analysis Brief	IWS, VISION
OPP.1.4	Develop CCIRs	MIPS, DCGS
OPP.1.4.1	Develop Initial CCIRs	JADOCS
OPP.1.4.2	Determine Recommended CCIRs	**Capability Gap**
OPP.1.4.3	Approve CCIRs	JADOCS
OPP.1.7	Develop Courses of Action	JADOCS, GIANT
OPP.1.7.1	Conduct Pre-COA Development Analysis	MIPS, DCGS
OPP.1.7.2	Develop Courses of Action	JADOCS, GIANT
OPP.1.7.3	Analyze Courses of Action	JADOCS, GIANT
OPP.1.7.4	Refine Courses of Action	JADOCS, GIANT
OPP.1.7.5	Perform COA Comparison	JADOCS, GIANT
OPP.1.7.6	Develop COA Decision Brief	NCES
OPP.1.7.7	Refine IPOE Based on COA Comparison	JADOCS, GIANT
OPP.1.9	Transition to Future Operational Planning	JADOCS
OPP.1.10	Prepare Plans/Orders	JSIPS, CPOF
OPP.1.10.1	Plan for Actions & Resources to Achieve Desired Effects	GCCS-I3
OPP.1.10.2	Develop Base Paragraphs for Operation Plans & Orders	FalconView, GCCS-I3
OPP.1.10.3	Develop Appropriate Annexes, Appendixes & Tabs	**Capability Gap**
OPP.1.10.4	Confirm Time-Phased Force & Deployment Data (TPFDD)	GCCS-I3
OPP.1.10.5	Assess Risk on Plans/Orders	DRRS
OPP.1.10.6	Reconcile Plans and Orders	**Capability Gap**
OPP.1.10.7	Back Brief & Crosswalk Orders	**Capability Gap**
OPP.1.10.8	Coordinate Plans & Tasking with other Components & Supporting Organizations	GCCS-M
OPP.1.12	Transition Orders Development to Execution	GCCS-M
OPP.1.12.1	Establish Maritime Support Request Process	MDA
OPP.1.12.2	Identify Maritime Support Requirements	JADOCS
OPP.1.12.3	Coordinate Maritime Support Requests	JADOCS
OPP.1.12.4	Adjudicate Maritime Support Requests	JADOCS
OPP.1.12.5	Determine Need to Modify COA	JADOCS, SCOPES, SBMCS, GIANT
OPP.1.12.6	Synchronize Tactical Plans & Tasks	DJC2
OPP.1.12.7	Make Maritime Support Requests Visible/Accessible	CANES
OPP.2.1	Analyze Existing OPORD for Operational Environment Requirements	JCRE
OPP.2.3	Analyze Operational Environment Control Measure Requests	JCRE, IWS, MIPS
OPP.2.5	Develop Initial Set of Operational Environment Control Measures	JCRE
OPP.2.6	Designate Operational Environment Control Sectors	CNDE, CANES, NCES
OPP.2.7	Designate Sector Operational Environment Control Authorities	CNDE, CANES, NCES
OPP.2.8	Establish Operational Environment Change Request Procedures	CNDE, CANES, NCES
OPP.2.9	Compile Operational Environment Control Plan	CNDE, CANES, NCES
OPP.2.4	Component Sub Control Request and Control Discussions	JCRE, IWS, MIPS

Table 10 - Systems Allocated to *Operational Planning* Functions (continued)

Functions		**Systems**
OPP.3.1	Assess CDRs Guidance for IO Implications	DJC2, VISION
OPP.3.2	Determine Most Appropriate Methods to Reach IO Objectives	JADOCS, VISION
OPP.3.3	Coordinate Operations Security	VISION
OPP.3.4	Coordinate Psychological Operations	VISION
OPP.3.5	Coordinate Computer Network Operations	VISION
OPP.3.6	Coordinate Electronic Warfare	VISION
OPP.3.7	Coordinate Military Deception	VISION
OPP.3.8	Integrate Information Operations Plans	RADIANT MERCURY
OPP.3.9	Develop IO Annex C	VISION
OPP.4.1	Establish Exercise Concept	JSIPS
OPP.4.2	Assign Personnel/Resources to Exercise	DJC2
OPP.4.3	Develop Participant Instructions	DJC2
OPP.4.4	Develop Master Scenario Event List	ExMan, JSIPS
OPP.4.5	Monitor Exercise Events	ExMan, JSIPS
OPP.4.6	Evaluate Exercise	ExMan, JSIPS
OPP.4.7	Document Exercise Results	ExMan, JSIPS
OPP.5.1	Develop Staff Estimate	JSIPS
OPP.5.2	Identify Movement Requirement	JCRE
OPP.5.2.1	Estimate Lift Requirements	GCCS-M
OPP.5.2.2	Describe Requirements in Logistics Terms	JCRE
OPP.5.2.3	Estimate Transportation Requirements	GCSS-CC/JTF, CFAST
OPP.5.2.4	Submit Transportation Requirements & Report	GCSS-CC/JTF, CFAST
OPP.5.3	Identify Transportation Requirements	GCSS-CC/JTF, CFAST
OPP.5.4	Assess Logistical Capability Organic/Inorganic Requirement	GCSS-CC/JTF, CFAST
OPP.5.4.1	Anticipate Capabilities & Logistics Needs	GCSS-CC/JTF, CFAST
OPP.5.4.2	Develop Logistics COA	GCSS-CC/JTF, CFAST
OPP.5.4.3	Monitor Strategic/Operational Tactical Situation	GCSS-CC/JTF, CFAST
OPP.5.4.4	Develop & Maintain Logistics COP	GCSS-CC/JTF, CFAST
OPP.5.4.5	Coordinate Field service Requirements	GCSS-CC/JTF, CFAST
OPP.5.8	Maintain Logistics Knowledge Base	GCSS-CC/JTF, CFAST
OPP.5.9	Terminate Sustainment	GCSS-CC/JTF, CFAST
OPP.5.5	Prioritize & Time Phase Requirements	GCCS-I3
OPP.5.6	Prepare Transportation Plans/Orders	GCSS-CC/JTF, CFAST
OPP.5.6.1	Plan Transportation Operations	GCSS-CC/JTF, CFAST
OPP.5.6.2	Apportion Transportation	GCSS-CC/JTF, CFAST
OPP.5.6.3	Allocate Transportation	GCSS-CC/JTF, CFAST
OPP.5.6.4	Establish/Manage Transportation Request Process	GCSS-CC/JTF, CFAST
OPP.5.6.5	Validate Transportation Request	GCSS-CC/JTF, CFAST
OPP.5.6.6	Task Transportation Assets	GCSS-CC/JTF, CFAST
OPP.5.7	Plan & Coordinate Embarkation/Debarkation	GCSS-CC/JTF, CFAST
OPP.5.7.1	Prepare Forces for Movement	GCSS-CC/JTF, CFAST
OPP.5.7.2	Establish Movement Criteria	GCSS-CC/JTF, CFAST
OPP.5.7.3	Coordinate Movement	GCSS-CC/JTF, CFAST
OPP.5.7.4	Validate Shipment	GCSS-CC/JTF, CFAST
OPP.5.10	Redeployment	GCSS-CC/JTF, CFAST
OPP.6.1	Examine Space Resources	SCOPES
OPP.6.2	Identify Space Assumptions	JWS

Table 10 - Systems Allocated to *Operational Planning* Functions (continued)

Functions		**Systems**
OPP.6.3	Analyze Space Capability	JWS
OPP.6.4	Analyze Foreign Space Reliance	JWS
OPP.6.5	Identify Political Constraints	JWS
OPP.6.6	Develop Space Tactics	JWS
OPP.6.7	Define Space Responsibilities	JWS
OPP.6.8	Identify Space Logistics Requirements	JWS
OPP.6.9	Identify Space Augmentation Requirements	JWS
OPP.6.10	Integrate Space Plan	JWS
OPP.7.1	Establish Salvage & Equipment Retrograde Measures	GCSS-CC/JTF, CFAST, JCRE
OPP.7.2	Send Equipment Retrograde Information	GCSS-CC/JTF, CFAST, JCRE
OPP.7.3	Identify Recoverable or Salvageable Gear	GCSS-CC/JTF, CFAST, JCRE
OPP.7.4	Coordinate & Conduct Equipment Recovery	GCSS-CC/JTF, CFAST, JCRE

Table 11 - Systems Allocated to *Manage Information* Functions

Functions		**Systems**
MI.1.1	Ensure Authorized Entities & Information Used	**Capability Gap**
MI.1.2	Adapt info Sharing to Accommodate Evolving Needs	**Capability Gap**
MI.1.3	Manage Information Management Cell	**Capability Gap**
MI.1.3.1	Manage Workgroup Managers (embedded/shared)	**Capability Gap**
MI.1.3.2	Provide Overall Info-Related Admin Support	MSRT
MI.1.3.3	Manage Electronic File Plan	**Capability Gap**
MI.1.3.4	Manage Messaging Services	TBMCS, DJC2
MI.1.3.5	Manage Suspense Control	**Capability Gap**
MI.1.3.6	Provide Component IM Cell Services	**Capability Gap**
MI.1.4	Provide/Publish Data/Information to Net-Centric Environment	CNDE, CANES
MI.1.4.1	Generate Discovery Metadata	CMA
MI.1.4.2	Associate Semantic and Structural Metadata	CNDE, CANES, CMA
MI.1.4.3	Identify Data/Information Requirements	COLISEUM
MI.1.4.4	Prioritize Data/Information Requirements	MSRT
MI.1.4.5	Designate Reporting Requirements	COLISEUM
MI.1.4.6	Request Data/Information	MSRT
MI.1.4.7	Make Data/Information Requirements Visible & Accessible	MDA
MI.1.4.8	Develop Data/Information	**Capability Gap**
MI.1.4.9	Publish Data/Information	NCES
MI.1.5	Conduct Data Management	CNDE, CANES
MI.1.5.1	Establish Database Management Procedures	C2PC, TDBM, TCO
MI.1.5.2	Conduct Distributed Archive	CNDE, CANES
MI.1.5.3	Determine Information Pedigree	**Capability Gap**
MI.1.5.4	Maintain Information Pedigree	**Capability Gap**
MI.1.5.5	Catalogue Information	CMMA
MI.1.5.6	Store Information	CANES/NCES
MI.1.5.7	Dispose of Information	CMMA
MI.1.6	Capture, Obtain & Distribute Lessons Learned	IWS
MI.1.7	Establish Digital Rules of Protocol	**Capability Gap**

Table 11 - Systems Allocated to *Manage Information* Functions (continued)

Functions		**Systems**
MI.1.8	Collect Data Information	CMMA, GFM
MI.1.8.1	Identify Data/Information Assets	CMA
MI.1.8.2	Prioritize Data/Information Assets	CMA
MI.1.8.3	Identify Subscription	**Capability Gap**
MI.1.8.4	Request Subscription	**Capability Gap**
MI.1.8.5	Access Data/Information	CNDE, CANES
MI.1.8.6	Evaluate Subscribed Data/Information	**Capability Gap**
MI.1.8.7	Update Subscription	**Capability Gap**
MI.1.8.8	Formulate Discovery Search	**Capability Gap**
MI.1.8.9	Discover Services	NCES
MI.1.9	Document Info Requirements/General Procedures	NCES
MI.1.10	Process Data/Information Distributively	CNDE, CANES
MI.1.10.1	Filter Data/Information	GALE-Lite
MI.1.10.2	Deconflict Data/Information	COLISEUM
MI.1.10.3	Aggregate Data/Information	CNDE, CANES
MI.1.10.4	Correlate Data/Information	NCCT, C2PC
MI.1.10.5	Perform Data/Information Transformation	DCTS
MI.1.10.6	Integrate/Fuse Data/Information	MDA
MI.1.10.7	Label Data/Information	Radiant Mercury, CENTRIXS
MI.1.11	Share Information Across Forces, COIs & Communities of Practice	MDA, NCES
MI.1.12	Determine if Info Sharing Meets COIs & CofPs Needs	MDA
MI.2.1	Develop Procedures for RFI Submission	MASTER, NCES, NIPRNET, SIPRNET
MI.2.2	Implement RFI Procedures	MASTER, NCES, NIPRNET, SIPRNET
MI.2.3	Validate RFI	MASTER, NCES, NIPRNET, SIPRNET
MI.2.4	Track RFIs	MASTER, NCES, NIPRNET, SIPRNET
MI.2.5	Draft Response to RFI	MASTER, NCES, NIPRNET, SIPRNET
MI.2.6	Submit RFI to HHQ	MASTER, NCES, NIPRNET, SIPRNET
MI.2.7	Disseminate RFI Response	MASTER, NCES, NIPRNET, SIPRNET
MI.3.1	Provide Information Governance	CMMA
MI.3.2	Plan Information Management	GCCS
MI.3.4	Compile IMP Input	GCCS
MI.3.5	Approve Component IMP	IWS, NIPRNET, SIPRNET, NCES
MI.3.3	Coordinate IMP	**Capability Gap**
MI.4.1	Assess Battle Rhythm	GCCS, DRRS, DJC2
MI.4.2	Align with HHQ Battle Rhythms	NCES
MI.4.3	Adjust Battle Rhythm	C2PC, NCES
MI.4.4	Approve /Document Commander's Battle Rhythm	NCES
MI.5.1	Identify C2 & Communications Resource Requirements	GCCS-M
MI.5.2	Tailor C2 Systems & Communications Resources as Required	DJC2
MI.5.2.5	Manage Net-Centric Environment Operations	CNDE, CANES

Table 11 - Systems Allocated to *Manage Information* Functions (continued)

Functions		**Systems**
MI.5.3	Coordinate C2 & Communications Resource Requirements	GCCS-M
MI.5.4	Promulgate Force Communications Plan	VisIOn
MI.5.5	Locate Service	GCSS-CC/JTF/JTF
MI.5.6	Connect to Service	GCSS-CC/JTF/JTF
MI.5.7	Login to Service	GCSS-CC/JTF/JTF
MI.5.8	Access Authorized Service	GCSS-CC/JTF/JTF
MI.5.9	Manage Net-Centric Environment Operations	CNDE, CANES, CENTRIXS
MI.5.10	Monitor Component Comm Links & Networks	CENTRIXS, NERMS
MI.6.1	Provide Computer Network Defense Services	**Capability Gap**
MI.6.2	Configure Protection Capabilities	NIPRNETnet, SIPRNETnet
MI.6.3	Coordinate Computer Network Operations	CENTRIXS
MI.6.4	Monitor Information Environment	CENTRIXS
MI.6.5	Detect Unauthorized Action	NIPRNETnet, SIPRNETnet, NERMS
MI.6.6	Analyze Network Anomalies	CENTRIXS,NIPRNETnet, SIPRNETnet
MI.6.7	Respond to Network Incident	NIPRNETnet, SIPRNETnet

Table 12 - Systems Allocated to *Establish Headquarters* Functions

Functions		**Systems**
EHQ.1.1	Establish Appropriate Organizational Relationships	GCCS-M
EHQ.1.6	Connect & Interface with Non-DoD Organizations	GCCS-M
EHQ.1.7	Establish Role-Based Knowledge Framework	GCCS-M
EHQ.1.8	Form Distributed Teams/COIs/CofP	GCCS-M, GCSS
EHQ.1.8.1	Access Subject Matter Expert & Essential Information	GCCS-M, GCSS
EHQ.1.8.2	Identify COI/CofP	GCCS-M
EHQ.1.8.3	Establish COI/CofP	GCCS-M
EHQ.1.8.4	Develop COI/CofP Charter	GCCS-M
EHQ.1.8.5	Prioritize Information Sharing Capabilities	GCCS-M, GCSS
EHQ.1.8.6	Identify Related COIs/CofPs	GCCS-M, GCSS
EHQ.1.8.7	Advertise COI/CofP	GCCS-M, GCSS
EHQ.1.8.8	Provide COI/CofP Environment	GCCS-M, GCSS
EHQ.1.8.9	Participate in COI/CofP	GCCS-M, GCSS
EHQ.1.8.10	Manage & Govern COI/CofP	GCCS-M, GCSS
EHQ.1.9	Manage Battle Rhythm	GCCS-M, GCSS
EHQ.1.10	Implement Best Practices	NCES, NIPRNETNET, SIPRNETNET, VTC
EHQ.1.2	Allocate Decision Authority/Rights	GCCS-M, GCCS-J, CENTRIX-M
EHQ.1.3	Delegate Organizational Authority for Mission Planning & Execution	GCCS-M, GCCS-J, CENTRIX-M
EHQ.1.4	Deploy MOC Forward Element	GCSS, GCCS-M, DJC2, C2PC, GCCS-J
EHQ.1.4.1	Identify Forward Element Requirements	GCSS, GCCS-M, DJC2

Table 12 - Systems Allocated to *Establish Headquarters* Functions (continued)

Functions		Systems
EHQ.1.4.2	Survey Prospective Deployment Site	GCSS, GCCS-M, C2PC, DJC2
EHQ.1.4.3	Develop/Update Threat Assessment	GCSS, GCCS-M, DJC2
EHQ.1.4.4	Develop/Update Vulnerability Assessment	GCSS, GCCS-M, DJC2
EHQ.1.4.5	Develop Criticality Assessment	GCSS, GCCS-M, DJC2
EHQ.1.4.6	Plan for Host Nation Support	GCCS-J
EHQ.1.4.7	Establish & Coordinate Security Procedures for Theater Forces & Means	GCSS, GCCS-M, DJC2
EHQ.1.4.8	Establish Collaboration Sessions on the Fly during Operations	GCSS, GCCS-M, NCES
EHQ.1.4.9	Manage Means of Communicating Operational Information	GCSS, GCCS-M
EHQ.1.4.10	Assess Effectiveness of C4 Systems	GCSS, GCCS-M
EHQ.1.4.11	Obtain Lodging for Personnel	DTS
EHQ.1.5	Transition Role of HQ	GCCS-M
EHQ.1.5.1	Establish Command Transition Criteria & Procedures	GCCS-M
EHQ.1.5.2	Establish Command Relationships to Enable Appropriate Coordination	GCCS-M
EHQ.1.5.3	Develop Joint Force Liaison/Augmentee Structure	GCCS-M, GCCS-J
EHQ.1.5.4	Establish Internal Staff Collaboration Structures & Processes	GCCS-M
EHQ.1.5.5	Define Specific Procedures for Allocating Capabilities/Forces	GCCS-M
EHQ.1.5.6	Define Specific Procedures for Exercising Capabilities/Forces	GCCS-M
EHQ.1.5.7	Define Specific Procedures for Tasking Capabilities/Forces	GCCS-M
EHQ.1.5.8	Define Specific Procedures for Transitioning C2	GCCS-M
EHQ.1.5.9	Execute C4 Policies & Procedures for the Joint Operations Area	GCCS-J, DCGS-N, TBMCS, CENTRIX-M
EHQ.1.11	Sub Component Interagency	**Capability Gap**
EHQ.2.1	Develop Training Plans and Programs	GCCS-M
EHQ.2.2	Provide/Execute Training for U.S. and Other Nation Units and Individuals	GCCS-M
EHQ.2.3	Assess Training	CENTRIX-M, GCCS-J, NCES

Table 13 - Systems Allocated to *Execute Plans* Functions

Functions		Systems
EP.1.1	Maintain Operational Information & Joint/Naval Forces Status	JADOCS
EP.1.1.1	Monitor Data Feeds to CIP/CTP/COP	DCGS-N, ADSI, C2BMC
EP.1.1.2	Maintain Common Intelligence Picture	CMMA
EP.1.1.3	Integrate Adversary & Friendly Data	JADOCS
EP.1.1.4	Manage Common Tactical Picture (CTP)	C2PC
EP.1.1.5	Integrate Common Tactical Pictures	C2PC
EP.1.1.6	Manage COP Tracks	C2PC
EP.1.1.7	Update COP Information	C2PC
EP.1.1.8	Add Amplifying Info to Tracks	JADOCS, C2PC
EP.1.1.9	Sanitize COP	C2PC

Table 13 - Systems Allocated to *Execute Plans* Functions (continued)

Functions		**Systems**
EP.1.1.10	Disseminate COP	JADOCS
EP.1.1.11	Assess COP Information	JADOCS, C2PC
EP.1.1.12	Collate COP Information	JADOCS
EP.1.1.13	View Tailored, Relevant Situational Information	DCGS-N, JADOCS
EP.1.2	Assure Adequate Control, Tracking & Management of Plans & Decisions	C2PC
EP.1.4	Execute Plans/Orders	JWICS, SVOIP, M3
EP.1.5	Conduct Operational Movement & Maneuver	DCGS-N, JADOCS, C2PC
EP.1.5.1	Deconflict the Operational Environment	DCGS-N, JADOCS, C2PC
EP.1.5.2	Direct Operational Movement	JADOCS
EP.1.5.3	Control Movement	C2PC
EP.1.5.4	Provide Joint Total Asset Visibility	DCGS-N
EP.1.5.5	Provide Status of Deployment Operations	DCGS-N, JADOCS, C2PC
EP.1.5.6	Conduct Operational Maneuver & Force Positioning	JADOCS, C2PC
EP.1.5.7	Provide Operational Mobility	JADOCS, C2PC
EP.1.6	Monitor Execution & Adapt Operations	DCGS-N
EP.1.6.1	Monitor Execution of Plans/Orders	M3, DCGS-N
EP.1.6.2	Manage Risk	GCCS-M/J
EP.1.6.3	Intervene in Subordinate Actions as Needed	C2PC
EP.1.6.4	Adapt Operations to Changing Situations thru Initiative & Self Synchronization	JADOCS, C2PC
EP.1.6.5	Modify/Revise Procedures & Schedules	C2PC
EP.1.6.6	Respond to Emerging Requests for Support from Peer/Subordinate Commands	C2PC
EP.1.3	Synchronize Execution Across All Domains	JADOCS, C2PC
EP.1.7	Collaboratively, Rapidly Replan Operations	C2PC
EP.2.1	Approve Planning Guidance	C2PC
EP.2.2	Develop Priority of Effort	GCCS-M/J/I3
EP.2.3	Shape Guidance w/Mission Partners' Concerns in Mind	GCCS-J
EP.2.4	Develop the Commander's Planning Guidance	GCCS-M/J/I3
EP.2.5	Make Commander's Planning Guidance Visible/Accessible	NCES
EP.3.1	Request Health Services Support	NCES
EP.3.2	Coordinate Health Service Allocation	DCGS-N, NCES
EP.3.3	Submit Patient Movement Request	M3
EP.3.4	Transmit MEDEVAC OPS Info	M3
EP.3.5	Receive MEDEVAC OPS Coordination Info	NCES, M3
EP.3.6	Coordinate Patient Movement	GCCS-M/J, NCES
EP.3.6.1	Administratively & Clinically Validate Patient	**Capability Gap**
EP.3.6.2	Locate Appropriate Medical Facilities	NCES, NIPRNET, SIPRNET
EP.3.6.3	Identify Evacuation Resources	GCCS-M/J, NCES, DCGS-N
EP.3.6.4	Integrate & Synchronize the Resources for Patient Evacuation	GCCS-M/J
EP.3.6.5	Plan Evacuation Route	Falconview
EP.3.6.6	Provide Patient Attendants & Movement Items	**Capability Gap**
EP.3.6.7	Move Patient	**Capability Gap**
EP.3.6.8	Provide In-transit Patient Visibility	DCGS-N, NCES
EP.3.7	Conduct Patient Evacuation	**Capability Gap**
EP.3.8	Obtain & Analyze Medical Information	NCES

Table 13 - Systems Allocated to *Execute Plans* Functions (continued)

Functions		Systems
EP.3.9	Manage Blood Program in Area of Operations	C2PC
EP.4.1	Receive Request for Frequency Assignment	IWS, Outlook
EP.4.2	Analyze and Ensure Spectrum Availability	AESOP
EP.4.3	Develop Electromagnetic Frequency Assignments	AESOP, C2PC
EP.4.5	Resolve Interference & Electromagnetic Effects Issues	AESOP
EP.4.4	Deconflict Spectrum Usage	IWS, Outlook
EP.5.1	Monitor & Analyze Current & Projected Unit Personnel Strengths	DRRS
EP.5.2	Initiate Personnel Staff Estimates	IWS, NCES, NIPRNET, SIPRNET, VTC
EP.5.3	Determine Effects of Personnel Strengths on Assigned Operations	DRRS
EP.5.4	Provide Headquarters Personnel & Infrastructure	**Capability Gap**
EP.5.4.1	Receive Personnel Request	NCES, M3
EP.5.4.2	Transmit Personnel Allocation Information	NCES, M3
EP.5.4.3	Provide Augmentation	**Capability Gap**
EP.5.4.4	Control Throughput of Personnel and MPE/S	NCES
EP.5.4.5	Request/Receive Personnel Information	NCES
EP.5.4.6	Send Personnel Transfer Information	NCES
EP.5.5	Process Manpower Management System Data	DRRS
EP.5.6	Provide Personnel Accounting and Strength Support	NCES
EP.5.7	Provide for Personnel Services	**Capability Gap**
EP.5.8	Joint Reception Process	DRRS
EP.6.9	Mission Planning & Force Execution	DCGS-N, ADSI, C2BMC, JADOCS
EP.6.1	Develop Maritime End State and Objectives	NCES
EP.6.2	Perform Target Development and Priorities	C2BMC, JADOCS
EP.6.3	Capabilities Analysis	NCES
EP.6.4	Develop Operational Targets	NCCT, JADOCS
EP.6.5	Develop Maritime Target List	NCCT, JADOCS
EP.6.6	Provide Maritime Target Process Decision	NCCT, JADOCS
EP.6.7	Provide Target Nominations to Higher HQ	NCCT, C2BMC, JADOCS
EP.6.8	Commander's Decision & Force Appointment	JMPS, C2BMC, JADOCS
EP.6.10	Prioritize & Integrate Collection Requirements	DCGS-N, C2BMC
EP.6.11	Conduct Weaponeering	JADOCS
EP.6.12	Conduct Force Allocation & Assessment	JMPS
EP.6.13	Develop Mission Timing & Synchronization	JMPS
EP.6.14	Develop tasking Orders to Maritime Forces	JMPS
EP.6.15	Process JIP TL/JIP CL/Asset Appointment	**Capability Gap**
EP.7.1	Forecast Vulnerability of Friendly Operations	SCOPES, SBMCS
EP.7.2	Recommend Force Enhancement Options	SCOPES
EP.7.3	Coordinate Space Control Assets	SCOPES, DMS, GCCS-J
EP.7.4	Deconflict Use of DoD Space Systems	SCOPES, DMS, GCCS-J
EP.7.5	Provide Tailored Space Training	**Capability Gap**
EP.7.6	Distribute Missile Warning Data	ADSI, C2BMC, DMS, GCCS-J
EP.8.1	Develop MOEs for Determining if Collection Tasks Are Being Answered	IWS, NIPRNET, SIPRNET, NCES, VTC
EP.8.2	Monitor & Evaluate Collection Strategies for Effectiveness	DCGS-N, NCES

Table 13 - Systems Allocated to *Execute Plans* Functions (continued)

Functions		**Systems**
EP.8.3	Assess RFI/CR Fulfillment	NCES
EP.8.4	Assess Sensor Grid Status, Configuration, Performance & Capabilities	DCGS-N
EP.8.6	Provide Operational Environment Awareness Operations Assessment	DCGS-N
EP.8.5	Identify Coverage Gaps & Redundancies, Consider RFF	NCES
EP.9.1	Execute Logistics Plans within Assigned Operational Area - Classes 1 thru9	Global Trader, GCSS(Thin)
EP.9.2	Develop/Maintain Logistics Base in JOA	**Capability Gap**
EP.9.3	Anticipate Response to Force Needs	Global Trader, GCSS(Thin)
EP.9.4	Provide for Movement in the Area of Operations	Global Trader, GCSS(Thin)
EP.9.5	Track & Manage Supplies	Global Trader, NCES, GCSS(Thin)
EP.9.6	Coordinate Ordnance Requirements	Global Trader, GCSS(Thin)
EP.9.7	Coordinate POL Requirements	Global Trader, GCSS(Thin)
EP.9.8	Provide for Sustainment of Equipment in the JOA	Global Trader, GCSS(Thin)
EP.9.8.1	Predict Repair/Maintenance Requirements	**Capability Gap**
EP.9.8.2	Sense Repair/Maintenance Requirements	**Capability Gap**
EP.9.8.3	Monitor Maintenance Capabilities & Status within the JOA	NCES
EP.9.8.4	Identify Repair/Maintenance Resources	NCES
EP.9.8.5	Establish Maintenance Priorities	Global Trader, GCSS(Thin)
EP.9.8.6	Receive Maintenance Schedule	M3, SharePoint, Outlook
EP.9.8.7	Provide Maintenance Schedule	M3, SharePoint, Outlook
EP.9.8.8	Provide Shipboard & Mobile Maintenance to Embarked Force	Global Trader, GCSS(Thin)
EP.9.9	Coordinate Support for the Forces in the JOA	Global Trader, C2PC, NCES, GCSS(Thin)
EP.9.9.1	Receive Supply Allocation Information	Global Trader, GCSS(Thin)
EP.9.9.2	Report Demand & Supply Transactions	Global Trader, DCGS-N, C2PC, GCSS(Thin)
EP.9.9.3	Sense Demand for Logistics Resources	Global Trader, DCGS-N C2PC, GCSS(Thin)
EP.9.9.4	Analyze Evolving Capabilities & Sustainment Requirements	NCES
EP.9.9.5	Process Transportation Request	Global Trader, DCGS-N, C2PC, GCSS(Thin)
EP.9.9.6	Schedule/Coordinate Replenishment	Global Trader, DCGS-N, GCSS(Thin)
EP.9.10	Monitor Critical Supply Support Capabilities	Global Trader, DCGS-N, C2PC, GCSS(Thin)
EP.10.2	Configure Netted Sensor Grid	**Capability Gap**
EP.10.3	Task Sensor	**Capability Gap**
EP.10.4	Collect & Transport Sensor Derived Data	DCGS-N
EP.10.4.1	Collect Data	DCGS-N
EP.10.4.2	Provide Sensor Data	DCGS-N
EP.10.4.3	Conduct Dynamic Cross-Cuing of Sensor Data	**Capability Gap**
EP.10.4.4	Provide Sensor Tip-Off	**Capability Gap**
EP.10.4.5	Capture Sensor Platform Data	DCGS-N, GALE-Lite

Table 13 - Systems Allocated to *Execute Plans* Functions (continued)

Functions		Systems
EP.10.5	Maintain SA of Mission, Tasking & Operational Environment	DCGS-N, C2PC
EP.10.1	Allocate ISR Resources	JWICS

APPENDIX B
ACRONYMS OF ASSIGNED SYSTEMS

ADSI	Air Defense Systems Integrator
AESOP	Afloat Electromagnetic Spectrum Operations Program
C2PC	Command and Control Personal Computer
CANES	Consolidated Afloat Networks and Enterprise Services
CENTRIX	Combined Enterprise Regional Information Exchange System
CFAST	Collaborative Force Analysis, Sustainment, and Transportation
CMA	Comprehensive Maritime Awareness
CNDE	Consolidated Net Centric Data Environment
COLISEUM	Community On-Line Intelligence System for End Users and Managers
CPOF	Command Post of the Future
DCGS-N	Distributed Common Ground System-Navy
DJC2	Deployable Joint Command and Control
DRRS	Defense Readiness Reporting System
ExMan	Exercise Manager
GALE	Generic Area Limitation Environment
GCCS	Global Command and Control System
GCCS-I3	Global Command and Control System-Integrated Imagery and Intelligence
GCCS-J	Global Command and Control System-Joint
GCCS-M	Global Command and Control System-Maritime
GCSS(Thin)	Global Combat Support System
GCSS-CC/JTF	Global Combat Support System - Combatant Commander/Joint Task Force
GFM	Global Force Manager
GIANT	GPS Interface and Navigation Tool
ISPAN	Integrated Strategic Planning and Analysis Network
IWS	Information Work Space
JADOCS	Joint Automated Deep Operations Coordination System
JCRE	Joint Collaborative Real Time Engagement
JMPS	Joint Mission Planning System
JSIPS	Joint Service Imagery Processing System
JWS	Joint Warfighting Space
M3	Multimedia Message Manager

APPENDIX B (continued)

MDA	Maritime Domain Awareness
MIPS	Maritime Interdiction Integrated Air and Missile Defense Planning System
MSRT	Maritime Support Request Tool
NCCT	Net-Centric Collaborative Targeting
NCES	Net-Centric Enterprise Services
NERMS	Navy Emergency Response Management System
NIPRNet	Non-Classified Internet Protocol Router Network
SBMCS	Space Battle Management Core System
SCOPES	Space Common Operating Picture and Exploitation System
SIPRNet	Secret Internet Protocol Router Network
SVOIP	Secret Voice Over Internet Protocol
TDBM	Tactical Database Management
VISION	Virtual Integrated Support for Information Operations Environment
VTC	Video Teleconference

WORKS CITED

Blanchard, B. S., & Fabrycky, W. J. (2006). *Systems Engineering and Analysis Fourth Edition.* Upper Saddle River: Pearson PrenticeHall.

Briscoe, B., Odlyzko, A., & Tilly, B. (2006, July). *IEEE Spectrum*. Retrieved 11 2, 2009, from IEEE.Org: http://spectrum.ieee.org/computing/networks/metcalfes-law-is-wrong/0

Buede, D. M. (2000). *The Engineering Design of Systems: Models and Mehtods.* New York, New York: Wiley & Sons, Inc

Davis, M. H. (2009, 11 2). Chief Systems Engineer - Shore. (L. D. Reynolds, Interviewer)

Department of the Navy Chief Information Officer. (n.d.). *Department of the Navy Enterprise Architecture Management View.* Retrieved June 26, 2009, from Department of the Navy Chief Information Officer: http://www.doncio.navy.mil/EATool/Documents/MHQMOCAV1080206.pdf

Director, Warfare Integration N6F. (2007). *Maritime Headquarters with Maritime Operations Center (MHQ with MOC) Systems Requirements.* Washington, D.C.: Chief of Naval Operations.

Director, Warfare Integration N6F. (2008). *Maritime Headquarters with Maritime Operations Center (MHQ with MOC) Systems Requirements.* Washington, D.C.: Chief of Naval Operations.

Hinton, G. D. (2006, September/October). Architecture-Based Systems Engineering. *ITEA Journal* , 11-12.

Joint Staff. (2002, July 1). *CJCSM 3500.04C, Universal Joint Task List (UJTL).* Retrieved August 18, 2009, from DTIC Online: www.dtic.mil/doctrine/jel/cjcsd/cjcsm/m350004c.pdf

Joint Staff. (2008, August 25). *CJCSM 3500.04E, Universal Joint Task List (UJTL).* Retrieved October 9, 2009, from DTIC Online: http://www.dtic.mil/doctrine/training/cjcsm3500_04e.pdf

Manthorpe, W. H. (1996). The Emerging Joint System of Systems: A Systems Engineering Challenge and Opportunity for APL. *John Hopkins APL Technical Digest , 17* (3), 305-310.

Naval Doctrine Publication 6 (NDP 6). (1995, May 19). Naval Command and Control.

U.S. Fleet Forces Command. (2007, March 13). Maritime Headquarters with Maritime Operations Center Concept of Operations (CONOPS). Norfolk, VA, United States of America: U.S. Department of the Navy.

Vitech Corporation. (2005). *CORE® 5 Systems Engineering Guided Tour.* Vienna, Virginia: Vitech Corporation.

COMPLETE LIST OF RESEARCHED REFERENCES

Blanchard, B. S., & Fabrycky, W. J. (2006). *Systems Engineering and Analysis Fourth Edition.* Upper Saddle River: Pearson PrenticeHall.

Briscoe, B., Odlyzko, A., & Tilly, B. (2006, July). *IEEE Spectrum*. Retrieved 11 2, 2009, from IEEE.Org: http://spectrum.ieee.org/computing/networks/metcalfes-law-is-wrong/0

Buede, D. M. (2000). *The Engineering Design of Systems: Models and Mehtods.* New York, New York: Wiley & Sons, Inc.

Captain Larry Slade, U. S. (2007, May 8). *Maritime Headquarters (MHQ) with Maritime Operations Centers (MOC).* Retrieved June 3, 2009, from AFCEA Hampton Roads Chapter: http://www.afceahamptonroads.org/ppt_files/0705_Slade_MHQ%20w%20MOC.ppt

Captain Mike Smack, U. S. (2007, April 10). *Office of Naval Research Science & Technology*. Retrieved October 9, 2009, from MHQ w/ MOC CONOPS Brief: https://www.onr.navy.mil/about/events/docs/300_MHQ%20w%20MOC%20CONOPS%20Brf%20to%20ONR%20Industry%20Day.pdf

Commander John J. Gordon, U. S. (2006). *Maritime Operational Threat Response Center: The Missing Piece in the National Strategy for Maritime Security*. Newport: Naval War College.

Davis, M. H. (2009, 11 2). Chief Systems Engineer - Large Decks. (L. D. Reynolds, Interviewer)

Department of the Navy Chief Information Officer. (n.d.). *Department of the Navy Enterprise Architecture Management View*. Retrieved June 26, 2009, from Department of the Navy Chief Information Officer: http://www.doncio.navy.mil/EATool/Documents/MHQMOCAV1080206.pdf

Director, Warfare Integration N6F. (2007). *Maritime Headquarters with Maritime Operations Center (MHQ with MOC) Systems Requirements.* Washington, D.C.: Chief of Naval Operations.

Director, Warfare Integration N6F. (2008). *Maritime Headquarters with Maritime Operations Center (MHQ with MOC) Systems Requirements.* Washington, D.C.: Chief of Naval Operations.

Hinton, G. D. (2006, September/October). Architecture-Based Systems Engineering. *ITEA Journal* , 11-12.

Joint Staff. (2002, July 1). *CJCSM 3500.04C, Universal Joint Task List (UJTL).* Retrieved August 18, 2009, from DTIC Online: www.dtic.mil/doctrine/jel/cjcsd/cjcsm/m350004c.pdf

Joint Staff. (2008, August 25). *CJCSM 3500.04E, Universal Joint Task List (UJTL).* Retrieved October 9, 2009, from DTIC Online: http://www.dtic.mil/doctrine/training/cjcsm3500_04e.pdf

Major Daniel R. Walker, U. S. (1996). *The Organization and Training of Joint Task Forces.* Maxwell Air Force Base: School of Advanced Airpower Studies.

Manthorpe, W. H. (1996). The Emerging Joint System of Systems: A Systems Engineering Challenge and Opportunity for APL. *John Hopkins APL Technical Digest , 17* (3), 305-310.

Mass Communications Specialist 2nd Class Alan Gragg, U. S. (2009, March 26). *U.S. 4th Fleet Stands Up Maritime Operations Center*. Retrieved June 3, 2009, from U.S. Navy Official Website: http://www.navy.mil/search/display.asp?story_id=43775

Naval Doctrine Publication 6 (NDP 6). (1995, May 19). Naval Command and Control.

Pei, R. S. (2000). Systems of Systems Integration (SoSI) - A Way of Acquiring Army C4I2WS Systems,. *Proceedings of the Summer Computer Simulation Conference,* (pp. 574-579).

Rechtin, E., & Maier, M. W. (1997). *The Art Of Systems Architecting.* Boca Raton: CRC Press, Inc.

U.S. Fleet Forces Command. (2007, March 13). Maritime Headquarters with Maritime Operations Center Concept of Operations (CONOPS). Norfolk, VA, United States of America: U.S. Department of the Navy.

Vitech Corporation. (2005). *CORE® 5 Systems Engineering Guided Tour.* Vienna, Virginia: Vitech Corporation.

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